Operating Instructions

Radiation-based sensor for continuous level and interface measurement

SOLITRAC 31

4 … 20 mA/HART - four-wire

With SIL qualification

Document ID: 43387

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Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

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1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained specialist personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence of actions**
Numbers set in front indicate successive steps in a procedure.

Battery disposal
This symbol indicates special information about the disposal of batteries and accumulators.

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

SOLITRAC 31 is a sensor for continuous level measurement.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a state-of-the-art instrument complying with IEC 61508 and all prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the corresponding Safety Manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.

2.5 CE conformity

The device fulfills the legal requirements of the applicable EC guidelines. By affixing the CE marking, VEGA confirms successful testing of the product.

Only with class A instruments:
The device is a class A instrument designed for use in an industrial environment. When used in a different environment, e.g., in a living area, the electromagnetic compatibility must be ensured by the user. If necessary, suitable screening measures against conducted and emitted disturbances must be taken.

You can find the conformity certificate in the download section under www.vega.com.

2.6 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfills the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for malfunction information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 – Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.7 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfill this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

3 Product description

3.1 Configuration

Type plate

The nameplate contains the most important data for identification and use of the instrument:

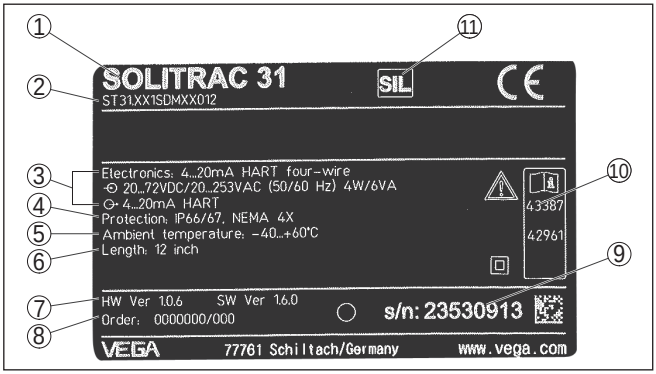

Fig. 1: Layout of the type label (example)

1 *Instrument type*
2 *Product code*
3 *Electronics*
4 *Protection rating*
5 *Ambient temperature*
6 *Measuring range*
7 *Hardware and software version*
8 *Order number*
9 *Serial number of the instrument*
10 *ID numbers, instrument documentation*

Serial number

The type label contains the serial number of the instrument. With it you can find the following data on our homepage:

- Product code of the instrument (HTML)
- Delivery date (HTML)
- Order-specific instrument features (HTML)
- Operating instructions at the time of shipment (PDF)
- Order-specific sensor data for an electronics exchange (XML)
- Test certificate pressure transmitters (PDF)

Go to www.vega.com, "*VEGA Tools*" and "*Serial number search*".

As an alternative, you can find the data via your Smartphone:

- Download the smartphone app "*VEGA Tools*" from the "*Apple App Store*" or the "*Google Play Store*"
- Scan the Data Matrix code on the type label of the instrument or
- Enter the serial number manually in the app

Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.6
- Software from 1.6.0

- Modification status electronics from -07

Electronics versions

The instrument is available in different electronics versions. Each version can be identified via the product code on the type label:

- Standard electronics type PT30E-XX

Scope of delivery

The scope of delivery encompasses:

- Radiation-based sensor
- Mounting accessory
- Documentation
  - this operating instructions manual
  - Safety Manual (SIL) PROTRAC series 30 (Document-ID 42961)
  - Operating instructions manual "*Display and adjustment module*" (optional)
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - if necessary, further certificates

3.2 Principle of operation

Application area

The instrument is suitable for applications in liquids and bulk solids in vessels under difficult process conditions. There are application possibilities in nearly all areas of industry.

The level is detected contactlessly right through the vessel wall. Neither a process fitting nor a vessel opening are required. The instrument is thus ideal for retro installation.

Functional principle

In radiation-based measurement, a Caesium-137 or Cobalt-60 isotope emits focussed gamma rays that are attenuated when penetrating the vessel wall and the medium. The PVT detector on the opposite side of the tank receives the radiation, whose strength is dependent on the level. The measuring principle has proven to be very reliable in conjunction with extreme process conditions because it measures contactlessly from outside through the vessel wall. The measuring system ensures maximum safety, reliability and plant availability, independently of the medium and its properties.

3.3 System limitations

There are several measuring principle-specific factors which can influence the measuring result. Keep these factors in mind in order to fully utilize the capabilities of the instrument with respect to measurement certainty and reproducibility.

Activity of the source

The implemented radioactive isotope and its activity must be selected according to the properties of the vessel and the medium. The necessary radioactive activity must be calculated on the basis of the plant data.

To this end, make use of our planning service for an optimum layout of the measurement and selection of the isotope. This applies particularly to SIL applications.

Due to the physical properties of the radioactive radiation, the pulse rate is subject to slight fluctuations. Set a suitable damping level to get a stable measured value.

Non-linearity of the process value

The relation between level and the pulse rate measured by the sensor is not linear.

Set up a linearization table to get a linear level signal. For precise mesurement results, make sure when setting up the linearization table that the actual filling height of the measuring points is entered as exactly as possible.

External radiation

External radiation sources can influence the measured value (e.g. welding joint tests). In safety-relevant applications, the safety function must be treated as unreliable as long as the external radiation occurs.

If necessary, you must take measures to maintain the safety function.

Span

Make sure during the planning that for the planned application, a possibly large different of the pulse rate with empty and full vessel is reaced. This applies mainly for products with low density or in vessels with extremely small diameter.

3.4 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"

- Relative humidity 20 … 85 %

3.5 Accessories and replacement parts

PLICSCOM

The display and adjustment module PLICSCOM is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor or the external display and adjustment unit and removed at any time.

You can find further information in the operating instructions "*Display and adjustment module PLICSCOM*" (Document-ID 27835).

VEGACONNECT

The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC. For parameter adjustment of these instruments, the adjustment software PACTware with VEGA-DTM is required.

You can find further information in the operating instructions "*Interface adapter VEGACONNECT*" (Document-ID 32628).

VEGADIS 81

The VEGADIS 81 is an external display and adjustment unit for VEGA plics® sensors.

For sensors with double chamber housing the interface adapter "*DIS-ADAPT*" is also required for VEGADIS 81.

You can find further information in the operating instructions "*VEGADIS 81*" (Document-ID 43814).

External indicating unit

The VEGADIS 62 is suitable for measured value indication of sensors. It is looped into the 4 … 20 mA/HART signal cable.

You can find further information in the operating instructions "*VEGADIS 62*" (Document-ID 36469).

Electronics module

The electronics module PT30E.XX is a replacement part for radiation-based sensors SOLITRAC 31.

The electronics module can only be exchanged by VEGA service technician.

3.6 Corresponding source container

A radioactive isotope in a suitable source holder is the prerequisite for a radiation-based measurement setup.

The handling of radioactive substances is regulated by law. The radiation protection rules of the country in which the system is operated apply first and foremost.

In Germany, for example, the current radiation protection ordinance (StrlSchV) based on the Atomic Energy Law (AtG) applies.

The following points are important for measurement with radiation-based methods:

Handling permit

A handling permit is required for operation of a system using gamma rays. This permit is issued by the respective government office or the

responsible authority (in Germany, for example, offices for environmental protection, trade supervisory boards, etc.)

You can find further instructions in the operating instructions manual of the source container.

General instructions for radiation protection

When handling radioactive sources, unnecessary radiation exposure must be avoided. An unavoidable radiation exposure must be kept as low as possible. Take note of the following three important measures:

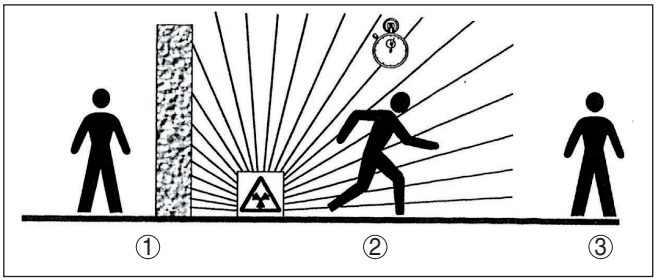

Fig. 2: Measures for protection against radioactive radiation

1 Shielding
2 Time
3 Distance

Shielding: Provide good shielding between the radioactive source and yourself as well as all other persons. Special source containers (e.g. VEGASOURCE) as well as all materials with high density (e.g. lead, iron, concrete, etc.) provide effective shielding.

Time: Stay as short a time as possible in radiation exposed areas.

Distance: Your distance to the source should be as large as possible. The local dose rate of the radiation decreases in proportion to the square of the distance to the radiation source.

Radiation safety officer

The plant operator must appoint a radiation safety officer with the necessary expert knowledge. He is responsible that the radiation protection ordinance is maintained and that all radiation protection measures are implemented.

Control area

Control areas are areas in which the local dose rate exceeds a certain value. Only persons who undergo official dose monitoring are allowed into these control areas. You can find the respectively valid limit values for control areas in the guideline of the respective authority (in Germany, for example, the radiation protection ordinance).

We are at your disposal for further information concerning radiation protection and regulations in other countries.

4 Mounting

4.1 General instructions

Switch off source

The source container is part of the measuring system. In case the source container is already equipped with an active isotope, the source container must be locked before mounting.

Danger:
Before mounting; make sure that the source is securely closed. Use a padlock to secure the source container in the closed condition and prevent it from being inadvertently opened.

Protection against moisture

Protect your instrument against moisture penetration through the following measures:

- Use the recommended cable (see chapter "*Connecting to power supply*")
- Tighten the cable gland
- Loop the connection cable downward in front of the cable gland

This applies particularly to:

- Outdoor mounting
- Installations in areas where high humidity is expected (e.g. through cleaning processes)
- Installations on cooled or heated vessels

Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions are particularly:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

You can find the specifications of the process conditions in chapter "*Technical data*" as well as on the nameplate.

Protective caps

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The openings for the cable glands are therefore covered with red protective caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

The suitable cable glands and blind plugs come with the instrument.

4.2 Mounting instructions

Installation position

Note:
Along with the planning, our specialists will analyse the conditions of the measurement loop to dimension the radiation source (isotope) accordingly.

You get a "Source Sizing" document specifying the required source activity and containing all relevant mounting information for your measuring point.

You must follow the instructions of this "Source Sizing" document in addition to the following mounting instructions.

The following mounting information is applicable as long as there is nothing else specified in the "Source Sizing" document.

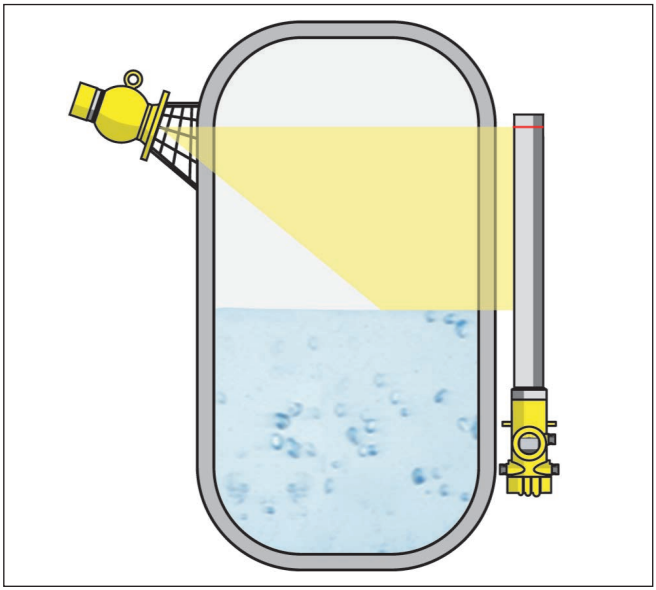

Fig. 3: Level measurement in a storage tank

You can find information on protective barriers and the mounting of the corresponding source container in the operating instructions manual of the source container, e.g. VEGASOURCE.

You can mount the SOLITRAC 31 with the housing head upward or downward. When the housing head is mounted downward, the housing itself is more easily accessible.

Fasten the sensor in such a way that it cannot fall out of the holder. If necessary, provide the sensor with a support from below.

Direct the exit angle of the source container to the SOLITRAC 31.

Mount the source container as close as possible to the vessel. If there are gaps, secure the area with a safety fence and protective grating so that no one can reach into the dangerous area.

Summation

To measure the level in very high vessels, multiple instruments can be cascaded.

Cascading means that two or several instruments are connected which can together cover a longer measuring range.

You can find the exact number of Slaves in the Safety Manual.

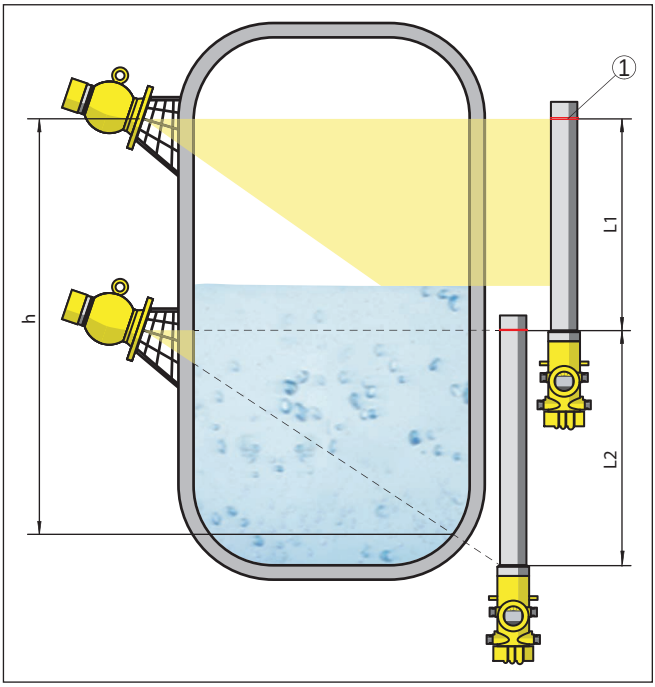

Fig. 4: Installation position - cascading arrangement

h Summed measuring range
L Measurement length (L1, L2)
1 Red marking line for designating the measuring range

Here, one instrument acts as a Master and all other instruments operate as Summation Slaves. The pulse rates of all instruments are summed in the Master instrument and converted into a common signal.

If several sensors are cascaded, the measuring ranges of the individual detectors must directly join each other. The detectors must also slightly overlap.

Make sure that the red marking lines directly join the measuring range of the next SOLITRAC 31.

Mount the SOLITRAC 31 in such a way that the detector tube is directly in the radiated area of the source container. Mount the SOLITRAC 31 preferably side by side and make sure that no detector tube is hidden by another sensor.

Vessel with heat insulation

On vessels with temperature insulation, the sensor and the source container should be preferably mounted outside of the tank insulation.

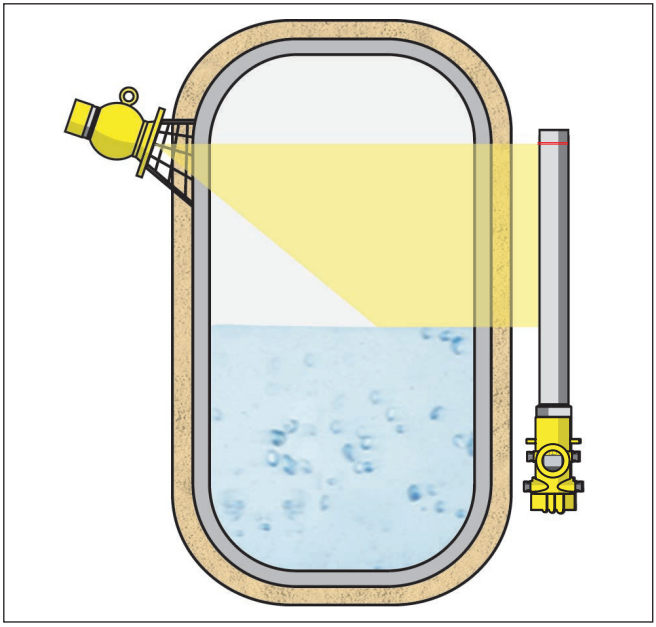

Fig. 5: Level measurement on a heated vessel with heat insulation

If this is not possible, make sure that there is a sufficiently large cut-out in the tank insulation for mounting the sensor and the source container. Make sure that the max. ambient temperature of the sensor is not exceeded.

Protection against heat

If the max. ambient temperature is exceeded, you must take suitable measures to protect the instrument against overheating.

You can protect the instrument by providing a suitable insulation against the heat or mounting the instrument further away from the heat source.

Make sure these measures are taken into account already in the planning stage. If you want to carry out such measures later on, contact our specialists to ensure that the accuracy of the application is not impaired.

If these measures are not sufficient to maintain the max. ambient temperature, you could consider using the water cooling system we offer for SOLITRAC 31.

The water cooling must also be included in the calculations for the measuring point. Contact our specialists regarding the dimensioning of the water cooling.

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, overvoltage arresters should be installed

Voltage supply via mains voltage

In this case, the instrument is designed in protection class II. To maintain this protection class, it is absolutely necessary that the ground conductor be connected to the internal ground terminal. Take note of the general installation regulations.

Supply voltage and current signal are carried on separate connection cables if reliable separation is required. The supply voltage range can differ depending on the instrument version.

The data for power supply are specified in chapter "*Technical data*".

Select connection cable

For power supply, an approved installation cable with PE conductor is required.

The 4 … 20 mA current output is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, screened cable should be used.

Use cable with a round wire cross section. An outer cable diameter of 6 … 12 mm (0.24 … 0.47 in) ensures the seal effect of the cable entry. If cable with a different diameter or wire cross section is used, exchange the seal or use an appropriate cable connection. Unused cable entry glands do not provide sufficient protection against moisture and must be replaced with blind plugs.

Cable entry

Generally provide all unused cable entries with suitable blind plugs. The thin foam rubber washers in the cable glands only serve as a dust cover during transport.

Cable gland ½ NPT

In the case of instrument housings with self-sealing NPT threads, it is generally not possible to have the cable glands screwed in at the factory. The openings for the cable glands are therefore covered with red protective caps as transport protection.

Before setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs. Unused cable glands do not provide sufficient protection against moisture and must be replaced with blind plugs.

The suitable cable glands and blind plugs come with the instrument.

Cable screening and grounding

If screened cable is necessary, connect the cable screen on both ends to ground potential. In the sensor, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the potential equalisation (low impedance).

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If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e. g. 1 nF, 1500 V). The low-frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

Warning:
Significant potential differences exist inside galvanization plants as well as on vessels with cathodic corrosion protection. Considerable equalisation currents can flow over the cable screen if the screen is grounded on both ends.

To avoid this, the cable screen in such applications must be connected only on one end to ground potential in the switching cabinet. The cable screen must **not** be connected to the inner ground terminal in the sensor and the outer ground terminal on the housing must **not** be connected to potential equalization!

Information:
The metal parts of the instrument are conductively connected with the inner and outer ground terminal on the housing. This connection is either a direct metallic connection or, in case of instruments with external electronics, a connection via the screen of the special connection cable.

You can find specifications on the potential connections inside the instrument in chapter "*Technical data*".

Connection technology

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

The connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

Connection procedure

Proceed as follows:

The procedure applies to instruments without explosion protection.

1. Unscrew the big housing cover
2. Loosen compression nut of the cable entry
3. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
4. Insert the cable into the sensor through the cable entry

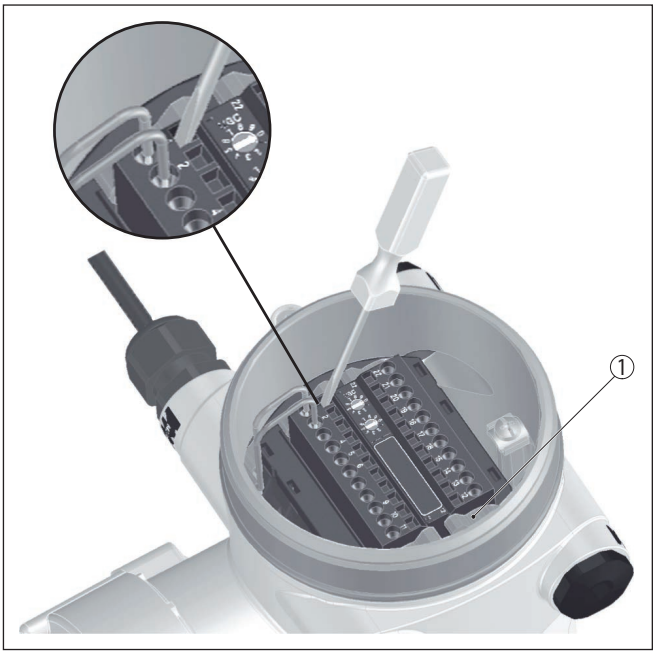


Fig. 6: Connection steps 4 and 5

1 Locking of the terminal blocks

5. Insert a small slotted screwdriver firmly into the rectangular lock openings of the respective connection terminal
6. Insert the wire ends into the round openings of the terminals according to the wiring plan

Information:
Solid cores as well as flexible cores with cable end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the rectangular lock opening with a small screwdriver; the terminal opening is freed. When the screwdriver is released, the terminal opening closes again.

7. Check the hold of the wires in the terminals by lightly pulling on them

   To loosen a line, insert a small slotted screwdriver firmly into the rectangular locking opening according to the illustration
8. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation
9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
10. Screw the housing cover back on

The electrical connection is hence finished.

Information:
The terminal blocks are pluggable and can be detached from the electronics. For this purpose loosen the two lateral locking levers of the terminal block with a small screwdriver. When loosening the locking, the terminal block is automatically squeezed out. It must snap in place when re-inserted.

5.2 Connection - Level measurement

Non-Ex instruments and instruments with non-intrinsically safe current output

Electronics and connection compartment - Non-Ex instruments and instruments with non-intrinsically safe current output

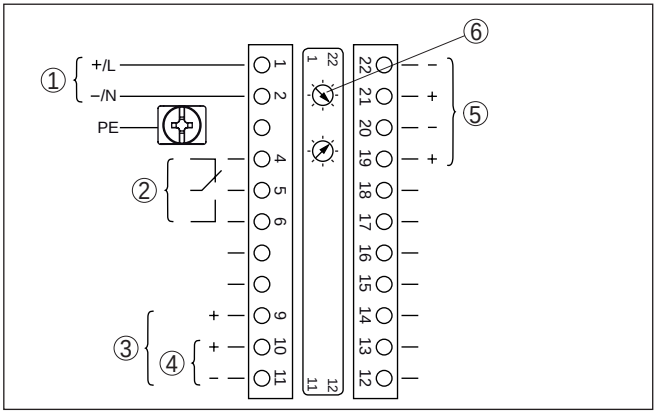


Fig. 7: Electronics and connection compartment with non-Ex instruments and instruments with non-intrinsically safe current output

1 *Voltage supply*
2 *Relay output*
3 *Signal output 4 … 20 mA/HART active*
4 *Signal output 4 … 20 mA/HART passive*
5 *Interface for sensor-sensor communication (MGC)*
6 *Setting the bus address for sensor-sensor communication (MGC)*[1)]

Adjustment and connection compartment - Non-Ex instruments and instruments with non-intrinsically safe current output

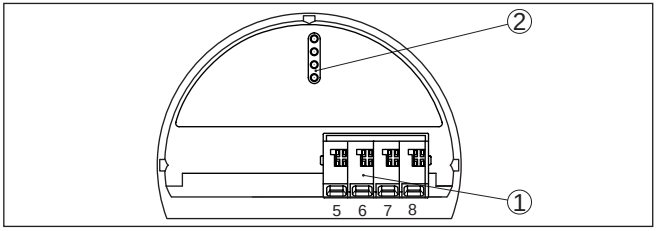


Fig. 8: Adjustment and connection compartment with non-Ex instruments and instruments with non-intrinsically safe current output

1 *Terminals for the external display and adjustment unit*
2 *Contact pins for the display and adjustment module or interface adapter*

1) MGC = Multi Gauge Communication

Instruments with intrinsically safe current output

You can find detailed information on the explosion-protected versions (Ex-ia, Ex-d) in the Ex-specific safety instructions. These safety instructions are part of the scope of delivery and come with the Ex-approved instruments.

Electronics and connection compartment - Instruments with intrinsically safe current output

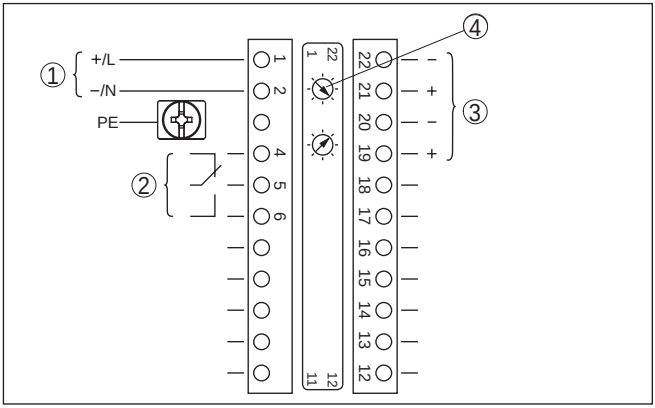


Fig. 9: Electronics and connection compartment (Ex-d) with instruments with intrinsically safe current output

1 *Voltage supply*
2 *Relay output*
3 *Interface for sensor-sensor communication (MGC)*
4 *Setting the bus address for sensor-sensor communication (MGC)*[2)]

Adjustment and connection compartment - Instruments with intrinsically safe current output

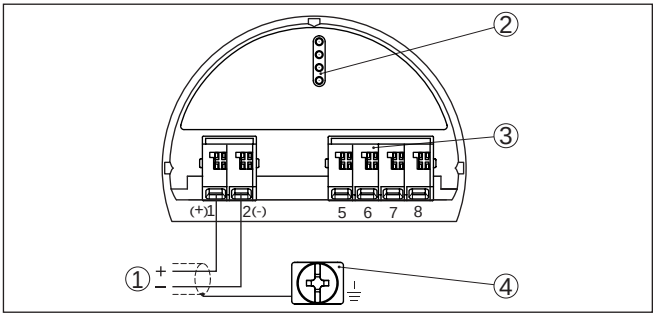


Fig. 10: Adjustment and connection compartment (Ex-ia) with instruments with intrinsically safe current output

1 *Terminals for intrinsically safe signal output 4 … 20 mA/HART active (not on versions with Ex-d approval)*
2 *Contact pins for the display and adjustment module or interface adapter*
3 *Terminals for the external display and adjustment unit*
4 *Ground terminal*

[2)] MGC = Multi Gauge Communication

5.3 Connection - Level detection

Non-Ex instruments and instruments with non-intrinsically safe current output

Electronics and connection compartment - Non-Ex instruments and instruments with non-intrinsically safe current output

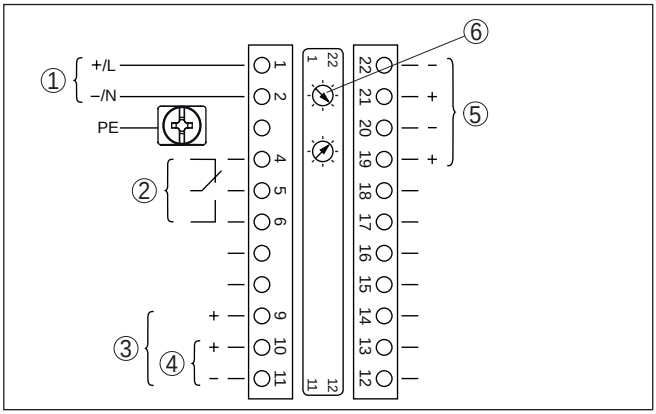


Fig. 11: Electronics and connection compartment with non-Ex instruments and instruments with non-intrinsically safe current output

1 *Voltage supply*
2 *Relay output*
3 *Signal output 8/16 mA/HART active*
4 *Signal output 8/16 mA/HART Multidrop passive*
5 *Interface for sensor-sensor communication (MGC)*
6 *Setting the bus address for sensor-sensor communication (MGC)*[3)]

Adjustment and connection compartment - Non-Ex instruments and instruments with non-intrinsically safe current output

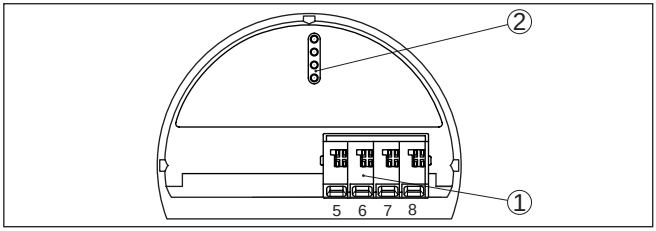


Fig. 12: Adjustment and connection compartment with non-Ex instruments and instruments with non-intrinsically safe current output

1 *Terminals for the external display and adjustment unit*
2 *Contact pins for the display and adjustment module or interface adapter*

Instruments with intrinsically safe current output

You can find detailed information on the explosion-protected versions (Ex-ia, Ex-d) in the Ex-specific safety instructions. These safety instructions are part of the scope of delivery and come with the Ex-approved instruments.

3) MGC = Multi Gauge Communication

Electronics and connection compartment - Instruments with intrinsically safe current output

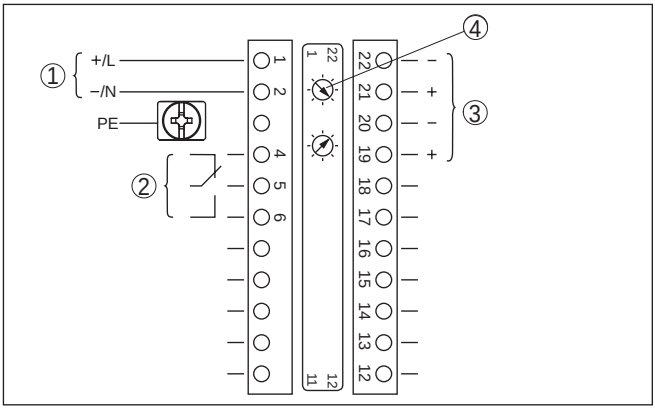


Fig. 13: Electronics and connection compartment (Ex-d) with instruments with intrinsically safe current output

1 *Voltage supply*
2 *Relay output*
3 *Interface for sensor-sensor communication (MGC)*
4 *Setting the bus address for sensor-sensor communication (MGC)*[4)]

Adjustment and connection compartment - Instruments with intrinsically safe current output

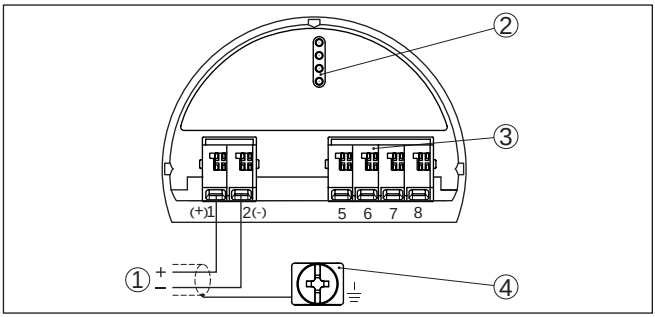


Fig. 14: Adjustment and connection compartment (Ex-ia) with instruments with intrinsically safe current output

1 *Terminals for intrinsically safe signal output 8/16 mA/HART (Multidrop) active (not on versions with Ex-d approval)*
2 *Contact pins for the display and adjustment module or interface adapter*
3 *Terminals for the external display and adjustment unit*
4 *Ground terminal*

5.4 Connection - Summation

Electronics and connection compartment - summation

To measure the level in very high vessels, multiple instruments can be cascaded.

Cascading means that two or several instruments are connected which can together cover a longer measuring range.

4) MGC = Multi Gauge Communication

The instrument acts as Master and all other instruments operate as Slaves.

The pulse rates of all instruments are summed in the Master instrument and converted into a common signal.

The Master instrument must have the function "Level". For this purpose, select under the menu item "*Setup/Application*" the function "Level".

Set the address setting (MGC) on the Master instrument to "0 - 0".

For this purpose, the Slave instruments must be defined as "Slave". Select under the menu item "*Setup/Application*" the function "Summation Slave".

The address setting (MGC) on the Slave instruments can be freely selected. Only the address "0 - 0" is reserved for the Master instrument.

Connect the instruments according to the following wiring plan:

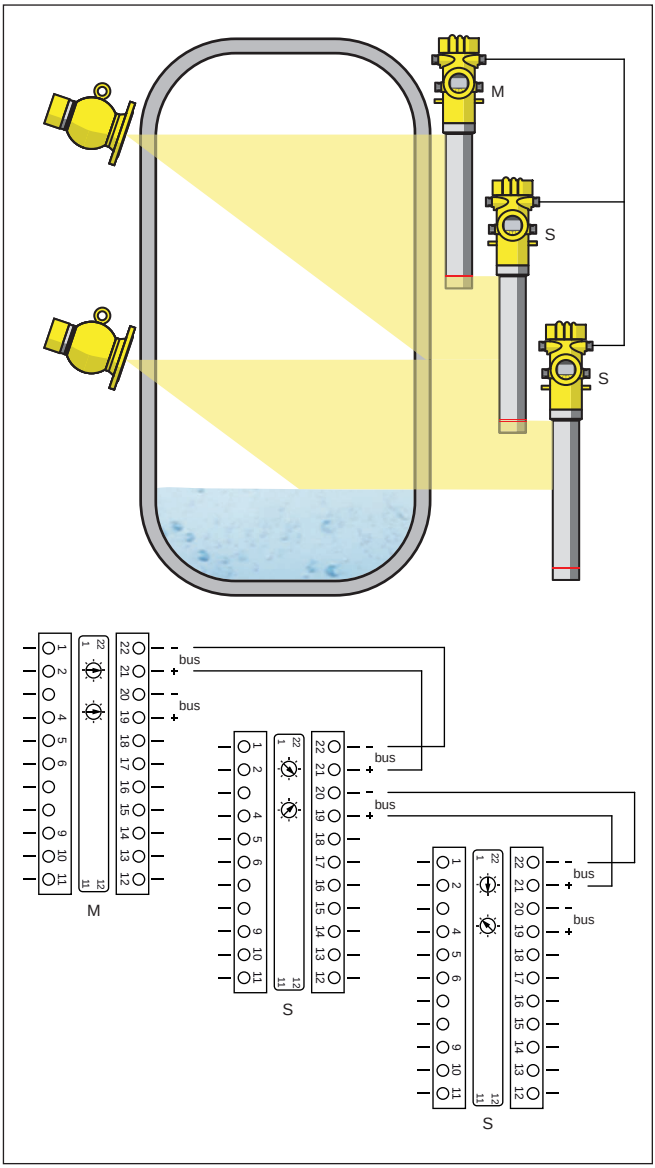


Fig. 15: Electronics and connection compartment with cascading of several instruments.

M Master instrument
S Slave instrument

Information:
For example, a radial connection would be also possible as an alternative. Take note of the polarity.

The selection of the two terminal pairs is individual.

6 Functional safety (SIL)

6.1 Objective

SIL

In case of dangerous outages, processing facilities and machines can cause risks for persons, environment and property. The risk of such outages must be judged by the plant operator. Dependent thereon are measures for risk reduction through error prevention, error detection and fault control.

The part of plant security depending on the correct functioning of safety-related components for risk reduction is called functional safety. Components used in such safety-instrumented systems (SIS) must therefore execute their intended function (safety function) with a defined high probability.

The safety requirements for such components are described in the international standard IEC 61508, which sets the measure for unique and comparable judgement of instrument safety and hence contributes to worldwide legal certainty. Depending on the degree of required risk reduction, we distinguish between four safety levels, from SIL1 for low risk to SIL4 for very high risk (SIL = Safety Integrity Level).

6.2 SIL qualification

Additional characteristics and requirements

When developing instruments which can be used in safety-instrumented systems, the focus is on avoiding systematical as well as determining and controlling random errors.

Here the most important characteristics and requirements from the perspective of functional safety according to IEC 61508:

- Internal monitoring of safety-relevant circuit parts
- Extended standardization of the software development
- In case of failure, switching of the safety-relevant outputs to a defined safe status
- Determination of the failure probability of the defined safety function
- Reliable parameterization with non-safe user environment
- Recurring function test

The SIL qualification of components is specified in a manual for functional safety (Safety Manual). Here, you can find all safety-relevant characteristics and information required by the user and planner for planning and operating the safety-relevant system. This document is attached to each instrument with SIL rating and can be also retrieved via the serial number search on our homepage.

6.3 Application area

The instrument can be used for level detection or level measurement of liquids and bulk solids in a safety-related system according to IEC 61508. Take note of the specifications in the Safety Manual.

The following inputs/outputs are permitted:

- Relay output

43387-EN-131119

- 4 … 20 mA current output

6.4 Safety concept of the parameterization

Tool for operation and parameterization

The following tools are permitted for parameterization of the safety function:

- The integrated display and adjustment unit for on-site adjustment
- The DTM suitable for the signal conditioning instrument in conjunction with an adjustment software according to the FDT/DTM standard, e. g. PACTware

Note:
For operation of the SOLITRAC 31 the DTM Collection version 1.67.2 or higher is required. The modification of safety-relevant parameters is only possible with active connection to the instrument (online mode).

Reliable parameterization

To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access. This concept applies to the adjustment on the instrument but also to adjustment with PACTware with DTM.

Safety-relevant parameters

For protection against unwanted or unauthorzed adjustment, the set parameters must be barred from unauthorized access. For this reason, the instrument is shipped in locked condition. The PIN in delivery status is "0000".

When shipped with a specific parameter adjustment, the instruments are accompanied by a list with the values deviating from the basic setting. By entering the serial number, the list is available as a download under "*www.vega.com/VEGA-Tools*".

After a change, all safety-relevant parameters must be verified and confirmed via a character string comparison.

The parameter settings of the measurement loop must be documented. For this purpose, the document "*SIL device settings*" is attached to each instrument listing all safety-relevant parameters in the shipping status as well as containing free space for own notes. This document is also available on our homepage. In addition, a list of the safety-relevant parameters can be stored and printed via PACTware/DTM.

Release adjustment

For each parameter change, the instrument must be unlocked via a PIN (see chapter "*Setup steps - Lock adjustment*"). The device status is indicated by the symbol of an unlocked or locked padlock.

Unsafe device status

Warning:
If adjustment is enabled, the safety function must be considered as unreliable. This applies until the parameterization is terminated correctly. If necessary, other measures must be taken to maintain the safety function.

Change parameter

All parameters changed by the operator are marked automatically so that they can verified in the next step.

Verify parameters/Lock adjustment

For the verification the PIN must be entered first and a comparison of two character strings must be carried out. The user must confirm that both character strings are identical, this is used to check the character representation and the communication channels. The verification texts are provided in German and with all other menu languages in English.

In a second step, all modified, safety-relevant parameters are listed, which must all be confirmed. After this process is finished, the instrument will be locked automatically and the safety function is guaranteed again.

Incomplete process

Warning:
If the described process was not carried out completely or correctly (e.g. interruption or voltage loss), the instrument remains in the released and hence unsafe status.

Instrument reset

Warning:
In case of a reset to basic settings, all safety-relevant parameters will also be reset to default. Therefore all safety-relevant parameters must be checked or readjusted.

7 Set up with the display and adjustment module

7.1 Insert display and adjustment module

Mount/Dismount display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the small housing cover
2. Place the display and adjustment module in the desired position on the electronics (you can choose any one of four different positions - each displaced by 90°)
3. Press the display and adjustment module onto the electronics and turn it to the right until it snaps in.
4. Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.

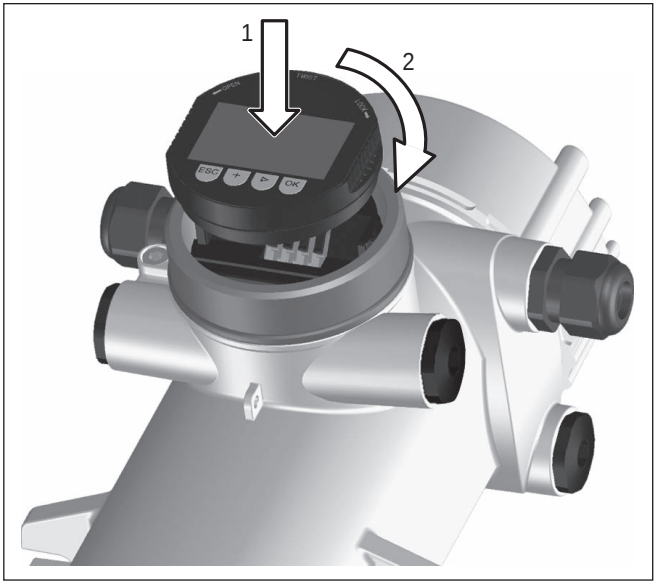


Fig. 16: Insert display and adjustment module

Note:
If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.

7.2 Adjustment system

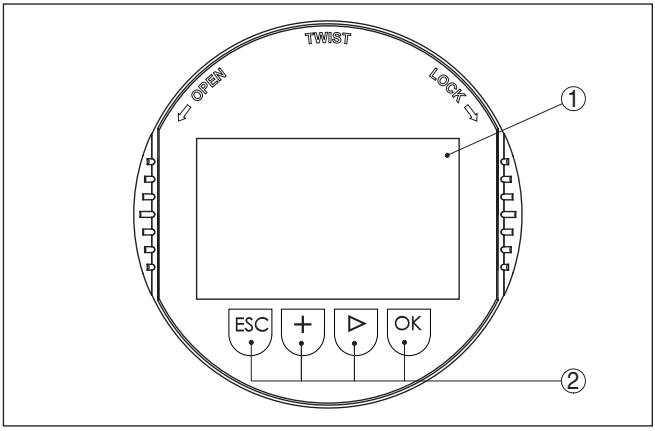


Fig. 17: Display and adjustment elements

1 LC display
2 Adjustment keys

Key functions

- ***[OK]*** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- ***[->]*** key:
  - Presentation, change measured value
  - Select list entry
  - Select editing position
- ***[+]*** key:
  - Change value of the parameter
- ***[ESC]*** key:
  - Interrupt input
  - Jump to next higher menu

Adjustment system

The device is adjusted via the four keys of the display and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

7.3 Parameter adjustment - Level measurement

The instrument is adapted to the application conditions via the parameter adjustment. The parameter adjustment is carried out with an adjustment menu.

Information:
In this operating instructions manual, the instrument-specific parameters are described. Further general parameters are described in the operating instructions manual "*Display and adjustment module*".

Instrument start

Caution:
During the first setup or after an instrument reset the instrument starts with preset standard values. These value are not suitable for your application and must be replaced by real values.

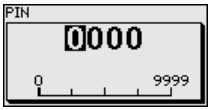
Carry out a setup in the sequence described in the following.

Lock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

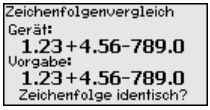
To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

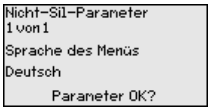


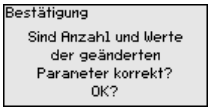
After a change, all safety-relevant parameters must be verified. For this purpose, a character string comparison must be carried out. This is used to check the character respresentation and the communication channels.

Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.



In a second step, all modified safety-relevant parameters are listed. Confirm the modified values.



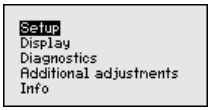


If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, e.g. for measurement loop name, isotope, application, background radiation, adjustment, signal output

Display: Settings, for example language, measured value display

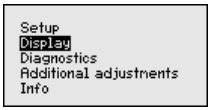
Diagnosis: Information, for example, of device status, peak value, simulation

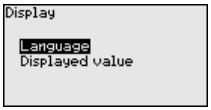
Additional adjustments: Instrument unit, reset, date/time, copying function

Info: Instrument name, hardware and software version, date of manufacture, instrument features

Procedure

Check if the correct language is already set for the display. If not, you can change the language in the menu item "*Display/Language*".





Start with the setup of SOLITRAC 31.

In the main menu point "*Setup*", the individual submenu points should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the measurement. The procedure is described in the following.

Stick with the normal sequence of the menu items as closely as possible.

Setup

Setup - Measurement loop name

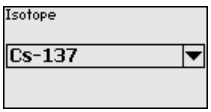
In this menu item you can assign an unambiguous name to the sensor or the measurement loop.

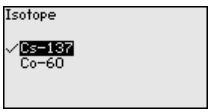
This parameter is described in the operating instructions manual "*Display and adjustment module*".

Setup/Isotope

In this menu item you can adjust the SOLITRAC 31 to the integrated isotope in the source container.

For this purpose, check which isotope is integrated in the source container. You can find this information on the type label of the source container.





Through this selection, the sensitivity of the sensor is adapted perfectly to the isotope. The normal reduction of the emitter activity is hence considered through the radioactive decay.

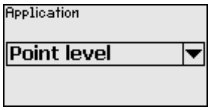
The SOLITRAC 31 requires this information of the automatic decay compensation. This ensures an interference-free measurement over the complete life time of the gamma emitter - an annual recalibration is not necessary.

Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup - Application

Enter here, the respective application.

This menu item enables adaptation of the sensor to the requested application. You can choose between the following applications: "*Level*", "*Point level*" or "*Summation Slave*".



Setup - Background radiation

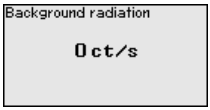
The natural radiation on earth influences the accuracy of the measurement.

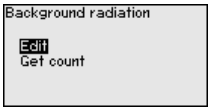
With this menu item the natural background radiation can be faded out.

For this purpose, the SOLITRAC 31 measures the natural background radiation and sets the pulse rate to zero.

In the future, the pulse rate from this background radiation will be automatically deducted from the total pulse rate. This means: only the component of the pulse rate originating from the source will be displayed.

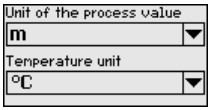
The source container must be closed for this setting.

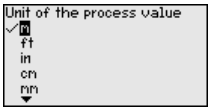


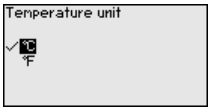


Setup - Units

In this menu item you can select the units of the process value and the temperature.



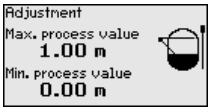




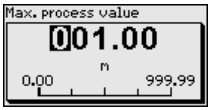
Setup - Adjustment

In this menu item you can enter the measuring range (min. and max. process value) of the sensor.

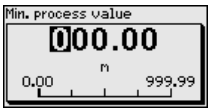
These settings influence the current output of the sensor.



Enter in the menu window "*Max. process value*" the max. level (full), for example in "*m*". This corresponds to an output current of 20 mA.



Enter in the menu window "*Min. process value*" the min. level (empty), for example in "*m*". This corresponds to an output current of 4 mA.



Setup/Linearisation

In this menu item you can carry out the adjustment of the sensor.

Caution:
During the first setup or after an instrument reset, the linearisation stands at the preset value pair (90000 ct/s ≙ 0 % and 0 ct/s ≙ 100 %). These values are not suitable for your application and must be replaced by real values. Delete this value pair in the following procedure and carry out the linearisation.

Due to the measuring principle, there is no linear relationship between pulse rate and level. Hence, this adjustment (i.e. linearisation) must in any case be carried out.

If you have a non-linear vessel (e.g. spherical tank), you have to carry out this adjustment with as many points as possible.

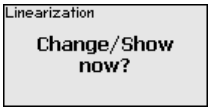
Note:
If you cannot fill the vessel with the original medium, it is also possible to carry out the adjustment with water.

Prerequisites:

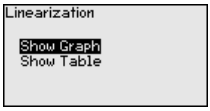
Radiation is switched on - Source container is set to "ON"

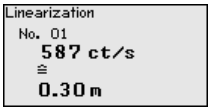
The vessel is either completely filled (100 %) or completely emptied (0 %).

Depending on the fact if the vessel is filled or emptied, you can carried out first the full or the empty adjustment. The SOLITRAC 31 sorts the points automatically according to their level.

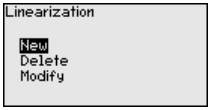


Select "*Show table*" to display and edit the linearization points.

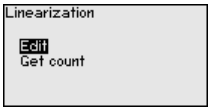




Select "*Linearization - New*" to enter the first point.

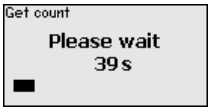


Select "*Determine count rate*" to enter the first point.



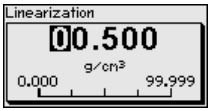
The determination of the actual count rate lasts 2 minutes. After the count rate has been determined, you can accept the value (ct/s).

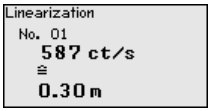
The count rate is stated in ct/s. This is the number of counts per second, i.e. the measured radioactive radiation dose actually reaching the sensor.



Enter now the corresponding level (m).

By doing so, you assign a respective level to the actual count rate.





Accept the value pair with "*OK*".

Depending if you have started with full or empty vessel, you have to continue emptying or filling the vessel.

Also carry out such a linearization with several different filling heights if you have a linear vessel.

By doing so, you can influence the measurement reliability of the sensor. The more linearization points you enter and the bigger the difference between the first and the last linearization point, the more reliable the measurement will be.

If you have a non-linear vessel (e.g. spherical tank), you have to carry out this adjustment with as many points as possible.

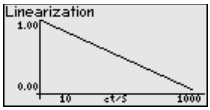
A maximum of 32 linearisation points is possible.

Note:
If you cannot fill the vessel during the adjustment procedure to at least 60 % of the max. level, it is possible to carry out the full adjustment by switching off the radiation. The switched-off radiation simulates a 100 % filling.

Because you have already set the background radiation to 0 in the menu item: "*Setup/Background radiation*", the measured pulse rate must be around 0 ct/s.

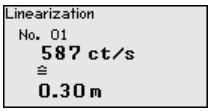
Show diagram

This menu item is only available if a linearization was already carried out.



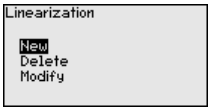
Show table

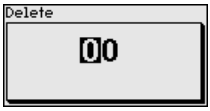
In this menu item you can show the individual value pairs of the linearization.



Linearization - Delete

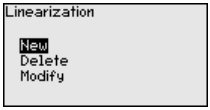
You can also delete individual linearization points.

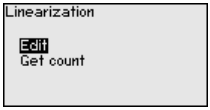


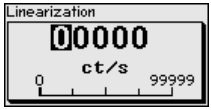


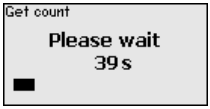
Linearization - Modify

You can also modify individual linearization points.





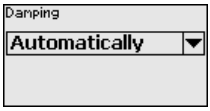


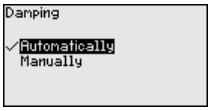


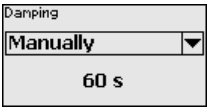
Setup/Damping

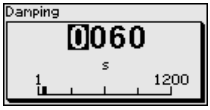
In this menu item you can adjust the damping of the sensor. With it you can suppress fluctuations in the measured value indication, caused e.g. by an agitated product surface. This time can be between 1 and 1200 seconds. Keep in mind that the reaction time also increases and the instrument reacts to quick level changes with a delay. Generally a time of approximately 60 seconds is sufficient to smooth the measured value indication.

With the setting "Automatic", the instrument itself calculates a suitable damping on the basis of the adjustment and the measured value changes. This setting is particularly suitable for application where fast and slow level changes occur.





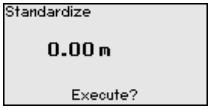


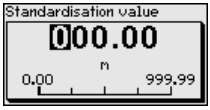


Setup/Real value correction

If you know the level at a certain height, you can enter in this menu item the determined real level to correct the measured value. The function shifts the linearization curve to this determined point.

With this procedure the measurement can be adapted exactly to the conditions in the vessel.



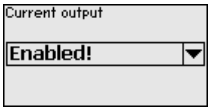


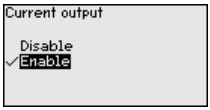
Setup/Current output

In this menu item you can activate or deactivate the current output.

The SOLITRAC 31 checks if with activated current output there is really an instrument connected.

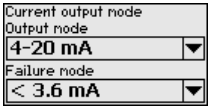
If no instrument is connected to the current output, you have to deactivate the current output.

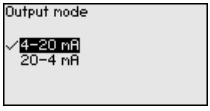


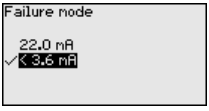


Setup/Current output mode

In this menu item you can define the characteristics of the sensor and its behaviour in case of a fault.



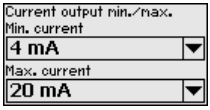


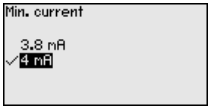


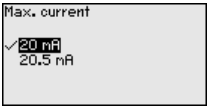
Setup/Current output Min./Max.

In this menu item you can define the behaviour of the current output.

You can determine the current with min. and max. level separately.







Setup/Relay

In this menu item you can activate the relay output and determine its function as well as the switching points.

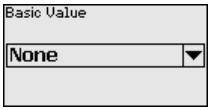
When the output of the process values is set, you can choose between overfill and dry run protection.

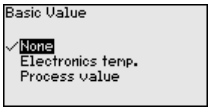
The relay outputs of the sensor react accordingly.

You can choose "no" reference value. In this case, the relay output operates as fail safe relay.

- None - Relay operates as fail safe relay
- Electronics temperature
- Process value

"No" reference value means that the relay output operates as fail safe relay.

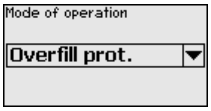


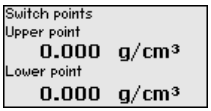


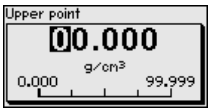
Push the ***[->]*** button, to reach the relay settings.

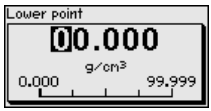
Example for the adjustment of the process value

First of all select the requested mode (overfill or dry run protection).









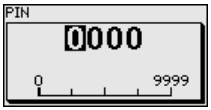
Caution:
Independent of the selected reference value, the relay will deenergize in case of failure.

Lock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

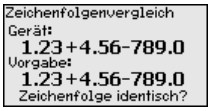
To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

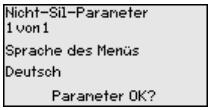


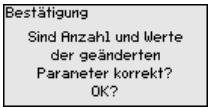
After a change, all safety-relevant parameters must be verified. For this purpose, a character string comparison must be carried out. This is used to check the character respresentation and the communication channels.

Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.



In a second step, all modified safety-relevant parameters are listed. Confirm the modified values.





If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

Display

Display - Language

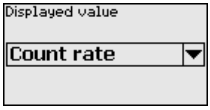
With this parameter you can change the display language.

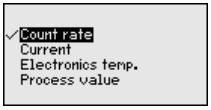
This parameter is described in the operating instructions manual "*Display and adjustment module*".

Display/Displayed value

With this parameter you can change the indication of the display.

You can choose if the display should show the actual pulse rate, the output current, the electronics temperature or the percentage value.





Diagnostics

Diagnostics - Device status

In this menu item, you can enquire the status of your sensor. In normal operation, the sensor displays the message "**OK**". In case of fault, you will find the corresponding fault code here.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Diagnosis - Peak value

The peak value function holds the max. and min. values during operation.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

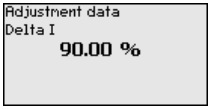
Diagnosis - Adjustment data

Here you can retrieve the adjustment value of the sensor. This is the percentage value of the difference of the min. and max. adjustment

points (Delta I). The value is an indication for the reliability and reproducibility of the measurement.

The higher the difference between the two adjustment points, the higher the differential value (Delta I) and the more reliable the measurement. A Delta I value below 10 % is an indication for a critical measurement.

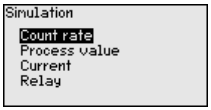
To increase the Delta I value, you have to increase the distance of the min. and max. adjustment points in the linearization.



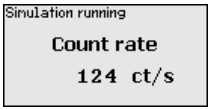
Diagnosis/Simulation

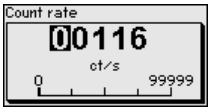
In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.

You can simulate different values:

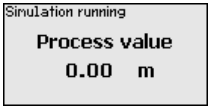


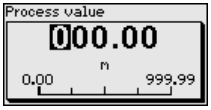
Pulse rate of the sensor



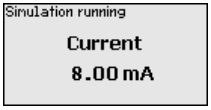


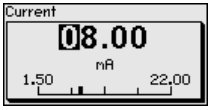
Process value



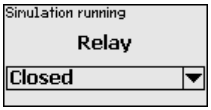


Current output





Switching function of the relay



Information:
The simulation is terminated automatically 60 minutes after the last key has been pressed.

Additional adjustments

Additional settings - PIN

In this menu item, the PIN is permanently activated/deactivated. Thus you protect the sensor data against unauthorized access and unintended changes. The default setting of the PIN is 0000.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

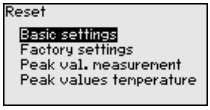
Additional adjustments - Date Time

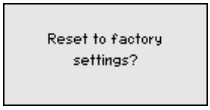
In this menu item you can set the actual date and time.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Additional adjustments/ Reset

When a reset is carried out, all settings (with only a few exceptions) are reset. The exceptions are: PIN, language, SIL and HART mode.





The following reset functions are available:

Basic settings: Resetting of the parameter adjustments to default values at the time of shipment. Order-specific settings are deleted.

Default settings: Resetting of the parameter adjustment like under "*Basic settings*". In addition, special parameters are reset to default values. Order-specific settings are deleted.

Peak values of measured value: Resetting of the parameter adjustments in the menu item "*Setup*" to the default values of the respective instrument. Order-specific settings remain but are not taken over into the current parameters.

Peak values of temperature: Resetting of the measured min. and max. temperatures to the actual measured value.

The following table shows the default values of the instrument. The values apply for the application "*Level*". First of all you have to select the application.

Depending on the instrument version, not all menu items may be available or they may be differently assigned:

Menu	Menu item	Default value
Setup	Measurement loop name	Sensor
	Isotope	Cs-137
	Application	Level
	Adjustment	0 %, 100 %
	Linearization	0 ct/s ≙ 100 %
		90000 ct/s ≙ 0 %
	Background radiation	0 ct/s
	Unit of the process value	%
	Temperature unit	°C
	Damping	60 s (manually)
	Real value correction	0
	Current output	Activated
	Current output mode	4 … 20 mA, < 3.6 mA
	Current output Min./Max.	Min. current 3.8 mA, max. current 20.5 mA
	Reference value - Relay	None
	Mode	Overfill protection
	Upper switching point - Process value	0 %
	Lower switching point - Process value	0 %
	Upper switching point - Temperature	50 °C
	Upper switching point - Temperature	25 °C
	Block adjustment	Released
	Address - Summation Slave	free
Display	Language	Selected language
	Displayed value	Pulse rate
	Display unit	ct/s
Additional adjustments	Temperature unit	°C
	Linearisation curve	Empty
	HART mode	Standard Address 0

Additional adjustments/ HART mode

With this function you can select the mode.

The sensor offers the HART modes standard and multidrop.

The mode 'Standard' with the fixed address 0 (factory setting) means output of the measured value as 4 … 20 mA signal.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Additional adjustments - Copy instrument settings

With this function

- Load parameter adjustment data from the sensor into the display and adjustment module
- Write parameter adjustment data from the display and adjustment module into the sensor

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Info

Info

In this menu you will find the following menu items:

- Instrument name - shows instrument name and serial number
- Instrument version - shows hardware and software version of the instrument
- Date of manufacture - shows calibration date and the date of the last change
- Instrument features - shows further instrument features

These parameters are described in the operating instructions manual "*Display and adjustment module*".

7.4 Parameter adjustment - Summation Slave

Cascading

To measure the level in very high vessels, multiple instruments can be cascaded.

Cascading means that two or several instruments are connected which can together cover a longer measuring range.

The instrument acts as Master and all other instruments operate as Slaves.

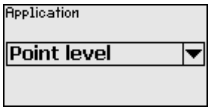
The pulse rates of all instruments are summed in the Master instrument and converted into a common signal.

First of all, define the function of the Slave instruments before you define the Master instrument. The Master instrument can thus immediately recognize the connected Slaves.

For this, the Slave instruments must be defined as "Summation Slave". Select under the menu item "*Setup/Application*" the function "Summation Slave".

The address setting (MGC) on the Slave instruments can be freely selected. Only the address "0 - 0" is reserved for the Master instrument.

The Master instrument must have the function "Level". For this purpose, select under the menu item "*Setup/Application*" the function "Level".



Set the address setting (MGC) on the Master instrument to "0 - 0".

You have to enter the addresses of the Slave instruments in the list of the Master instrument. This function is not possible in the supply and

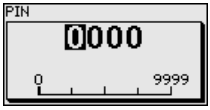
adjustment module. To do this you need PACTware with the respective DTM.

Lock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

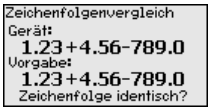
To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

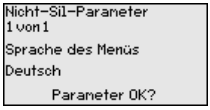


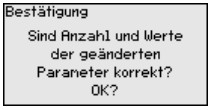
After a change, all safety-relevant parameters must be verified. For this purpose, a character string comparison must be carried out. This is used to check the character respresentation and the communication channels.

Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.



In a second step, all modified safety-relevant parameters are listed. Confirm the modified values.



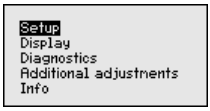


If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, e.g. for measurement loop name, isotope, application, background radiation, adjustment, signal output

Display: Settings, for example language, measured value display

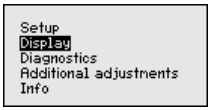
Diagnosis: Information, for example, of device status, peak value, simulation

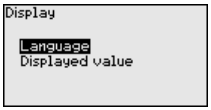
Additional adjustments: Instrument unit, reset, date/time, copying function

Info: Instrument name, hardware and software version, date of manufacture, instrument features

Procedure

Check if the correct language is already set for the display. If not, you can change the language in the menu item "*Display/Language*".





Start with the setup of SOLITRAC 31.

In the main menu point "*Setup*", the individual submenu points should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the measurement. The procedure is described in the following.

Stick with the normal sequence of the menu items as closely as possible.

Setup

Setup - Measurement loop name

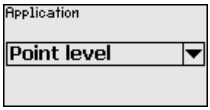
In this menu item you can assign an unambiguous name to the sensor or the measurement loop.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Setup - Application

Enter here, the respective application.

This menu item enables adaptation of the sensor to the requested application. You can choose between the following applications: "*Level*", "*Point level*" or "*Summation Slave*".

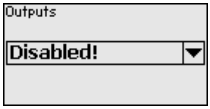


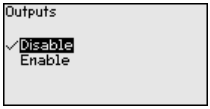
Setup/Outputs

In this menu item you can activate the function of the current output.

When the output is activated, the instrument remains in its function as a Slave, but the 4 … 20 mA output of the SOLITRAC 31 can be also used als single instrument.

When the output is active, the instrument has the complete functionality of a level measuring instrument. In this case, continue reading under "*Parameter adjustment/Level measurement*".



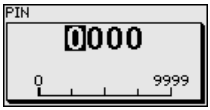


Lock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

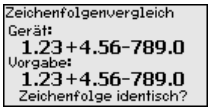
To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

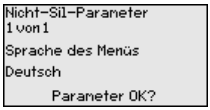


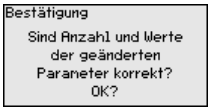
After a change, all safety-relevant parameters must be verified. For this purpose, a character string comparison must be carried out. This is used to check the character respresentation and the communication channels.

Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.



In a second step, all modified safety-relevant parameters are listed. Confirm the modified values.





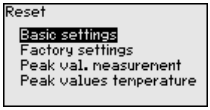
If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

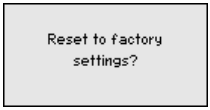
Otherwise the instrument remains in the released and hence unsafe condition.

Additional adjustments

Additional adjustments - Reset

When a reset is carried out, all settings (with only a few exceptions) are reset. The exceptions are: PIN, language, SIL and HART mode.





The following reset functions are available:

Basic settings: Resetting of the parameter adjustments to default values at the time of shipment. Order-specific settings are deleted.

Default settings: Resetting of the parameter adjustment like under "*Basic settings*". In addition, special parameters are reset to default values. Order-specific settings are deleted.

Peak values of measured value: Resetting of the parameter adjustments in the menu item "*Setup*" to the default values of the respective instrument. Order-specific settings remain but are not taken over into the current parameters.

Peak values of temperature: Resetting of the measured min. and max. temperatures to the actual measured value.

The following table shows the default values of the instrument. The values apply for the application "*Level*". First of all you have to select the application.

Depending on the instrument version, not all menu items may be available or they may be differently assigned:

Menu	Menu item	Default value
Setup	Measurement loop name	Sensor
	Isotope	Cs-137
	Application	Summation Slave
	Outputs	Deactivated
	Adjustment	0 %, 100 %
	Linearization	0 ct/s ≙ 100 %
		90000 ct/s ≙ 0 %
	Background radiation	0 ct/s
	Unit of the process value	%
	Temperature unit	°C
	Damping	60 s (manually)
	Real value correction	0
	Current output	Deactivated
	Current output mode	4 … 20 mA, < 3.6 mA
	Current output Min./Max.	Min. current 3.8 mA, max. current 20.5 mA
	Reference value - Relay	None
	Mode	Overfill protection
	Upper switching point - Process value	0 %
	Lower switching point - Process value	0 %
	Upper switching point - Temperature	50 °C
	Upper switching point - Temperature	25 °C
	Block adjustment	Released
	Address - Summation Slave	free
Display	Language	Selected language
	Displayed value	Pulse rate
	Display unit	ct/s
Additional adjustments	Temperature unit	°C
	Linearisation curve	Empty
	HART mode	Standard Address 0

7.5 Parameter adjustment - Point level detection

The instrument is adapted to the application conditions via the parameter adjustment. The parameter adjustment is carried out with an adjustment menu.

Information:
In this operating instructions manual, the instrument-specific parameters are described. Further general parameters are described in the operating instructions manual "*Display and adjustment module*".

Instrument start

Caution:
During the first setup or after an instrument reset the instrument starts with preset standard values. These value are not suitable for your application and must be replaced by real values.

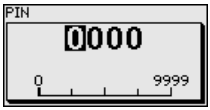
Carry out a setup in the sequence described in the following.

Lock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

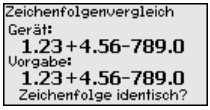
To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

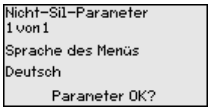


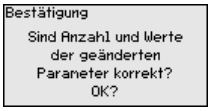
After a change, all safety-relevant parameters must be verified. For this purpose, a character string comparison must be carried out. This is used to check the character respresentation and the communication channels.

Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.



In a second step, all modified safety-relevant parameters are listed. Confirm the modified values.



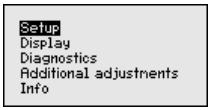


If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, e.g. for measurement loop name, isotope, application, background radiation, adjustment, signal output

Display: Settings, for example language, measured value display

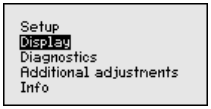
Diagnosis: Information, for example, of device status, peak value, simulation

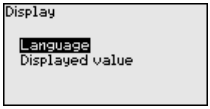
Additional adjustments: Instrument unit, reset, date/time, copying function

Info: Instrument name, hardware and software version, date of manufacture, instrument features

Procedure

Check if the correct language is already set for the display. If not, you can change the language in the menu item "*Display/Language*".





Start with the setup of SOLITRAC 31.

In the main menu point "*Setup*", the individual submenu points should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the measurement. The procedure is described in the following.

Stick with the normal sequence of the menu items as closely as possible.

Setup

Setup - Measurement loop name

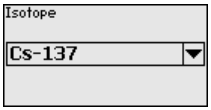
In this menu item you can assign an unambiguous name to the sensor or the measurement loop.

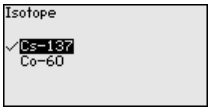
This parameter is described in the operating instructions manual "*Display and adjustment module*".

Setup/Isotope

In this menu item you can adjust the SOLITRAC 31 to the integrated isotope in the source container.

For this purpose, check which isotope is integrated in the source container. You can find this information on the type label of the source container.





Through this selection, the sensitivity of the sensor is adapted perfectly to the isotope. The normal reduction of the emitter activity is hence considered through the radioactive decay.

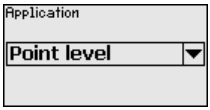
The SOLITRAC 31 requires this information of the automatic decay compensation. This ensures an interference-free measurement over the complete life time of the gamma emitter - an annual recalibration is not necessary.

Enter the requested parameters via the appropriate keys, save your settings with ***[OK]*** and jump to the next menu item with the ***[ESC]*** and the ***[->]*** key.

Setup - Application

Enter here, the respective application.

This menu item enables adaptation of the sensor to the requested application. You can choose between the following applications: "*Level*", "*Point level*" or "*Summation Slave*".



Setup - Background radiation

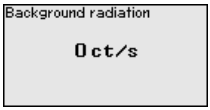
The natural radiation on earth influences the accuracy of the measurement.

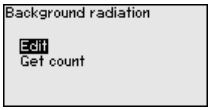
With this menu item the natural background radiation can be faded out.

For this purpose, the SOLITRAC 31 measures the natural background radiation and sets the pulse rate to zero.

In the future, the pulse rate from this background radiation will be automatically deducted from the total pulse rate. This means: only the component of the pulse rate originating from the source will be displayed.

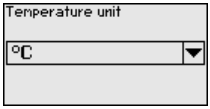
The source container must be closed for this setting.

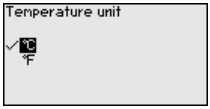




Setup/Unit

In this menu item you can select the temperature unit.





Setup - Adjustment mode

in this menu item you can select if you want to carry out a single or double point adjustment on the sensor.

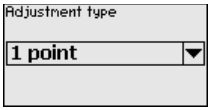
With the double point adjustment, the Delta I value is selected automatically.

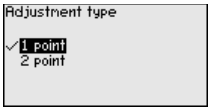
We recommend selecting the double point adjustment. To use this, you must be able to change the level of the vessel so as to carry out

the adjustment of the sensor with full status (covered) and with empty status (uncovered).

Hence, you will get a very reliable switching point.

With single point adjustment, you have to define the difference between the min. and max. adjustment points (Delta I) yourself during the following setup.





Setup/Adjustment uncovered (single point adjustment)

This menu item appears only if you have selected "**Single point adjustment**" as adjustment mode (Setup/Adjustment mode).

In this menu item you determine the point at which the SOLITRAC 31 should switch in uncovered status.

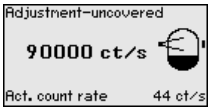
Empty the vessel until the sensor is uncovered.

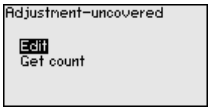
For this enter the requested pulse rate manually or let the rate be determined by SOLITRAC 31. Automatic determination of the pulse rate should be given preference.

The pulse rate is entered in ct/s. This is the number of counts per second, i.e. the measured gamma radiation reaching the sensor.

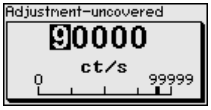
Prerequisites:

- Radiation is switched on - Source container is set to "ON"
- There is no medium between source container and sensor





You can enter the value for "*Adjustment uncovered*" (ct/s) manually.



You can have the value for "*Adjustment uncovered*" determined by SOLITRAC 31.

Setup/Delta I (single point adjustment)

This menu item appears only if you have selected "**Single point adjustment**" as adjustment mode (Setup/Adjustment mode).

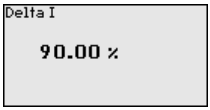
In this menu item you can adjust at which percentage value of the max. pulse rate the sensor should switch over.

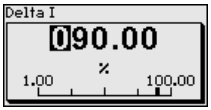
Since in most cases the radiation is almost completely absorbed when the sensor is covered, the pulse rate when the sensor is covered is very low.

The change between the two statuses is sufficiently clear.

Hence a percentage value of 90 % for the Delta I value is recommended.

You select lower values for sensitive detection of material cones or buildup which cause only partial absorption of the radiation.





Adjustment "covered" (two-point adjustment)

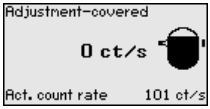
This menu item appears only if you have selected under adjustment mode (setup/adjustment mode) the "**Two-point adjustment**".

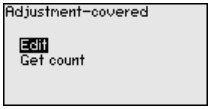
In this menu item you can set the min. pulse rate (ct/s) at which the sensor should switch over.

Fill the vessel until the SOLITRAC 31 is covered.

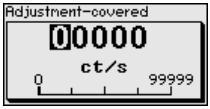
You thus get the min. pulse rate (ct/s) for the "covered" adjustment.

Enter the requested pulse rate manually or let the rate be determined by SOLITRAC 31. Automatic determination of the pulse rate should be given preference.





You can enter the adjustment point (ct/s) manually.



You can let the adjustment point be determined by SOLITRAC 31.

Adjustment "uncovered" (two-point adjustment)

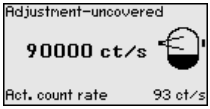
This menu item appears only if you have selected under adjustment mode (setup/adjustment mode) the "**Two-point adjustment**".

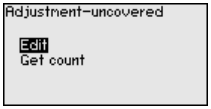
In this menu item you can set the max. pulse rate (ct/s) at which the sensor should switch over.

Empty the vessel until the SOLITRAC 31 is uncovered.

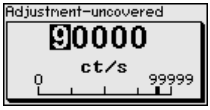
You thus get the max. pulse rate (ct/s) for the "uncovered" adjustment.

Enter the requested pulse rate manually or let the rate be determined by SOLITRAC 31. Automatic determination of the pulse rate should be given preference.





You can enter the adjustment point (ct/s) manually.



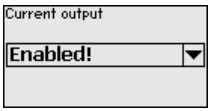
You can let the adjustment point be determined by SOLITRAC 31.

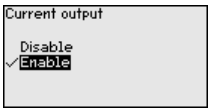
Setup/Current output

In this menu item you can activate or deactivate the current output.

The SOLITRAC 31 checks if with activated current output there is really an instrument connected.

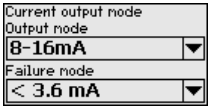
If no instrument is connected to the current output, you have to deactivate the current output.



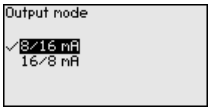


Setup/Current output mode

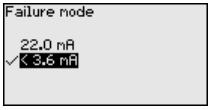
In this menu item you can select the switching behaviour of the sensor.



You can choose between an 8 - 16 mA characteristics or a 16 - 8 mA characteristics.



In this menu item you can also define the switching behaviour in case of fault. You can select if the current output should output 22 mA or < 3.6 mA in case of fault.



Setup/Relay

In this menu item you can select which mode the sensor should operate in.

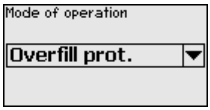
You can choose between overfill and dry run protection.

The relay outputs of the sensor react accordingly.

Overfill protection = the relay will deenergise (safe condition) when the max. level is reached.

Dry run protection = the relay will deenergise (safe condition) when the min. level is reached.

Make sure that you have selected the correct characteristics. See menu item "*Setup/Current output mode*".

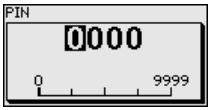


Lock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

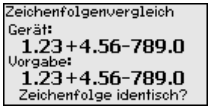
To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is "0000".

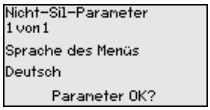


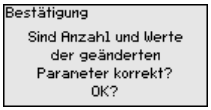
After a change, all safety-relevant parameters must be verified. For this purpose, a character string comparison must be carried out. This is used to check the character respresentation and the communication channels.

Confirm if the two character strings are identical. The verification texts are provided in German and with all other menu languages in English.



In a second step, all modified safety-relevant parameters are listed. Confirm the modified values.





If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

Display

Display - Language

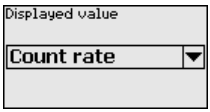
With this parameter you can change the display language.

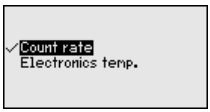
This parameter is described in the operating instructions manual "*Display and adjustment module*".

Display/Displayed value

With this parameter you can change the indication of the display.

You can choose if the display should show the actual pulse rate or the electronics temperature.





Diagnostics

Diagnostics - Device status

In this menu item, you can enquire the status of your sensor. In normal operation, the sensor displays the message "**OK**". In case of fault, you will find the corresponding fault code here.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Diagnosis - Peak value

The peak value function holds the max. and min. values during operation.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Diagnosis - Adjustment data

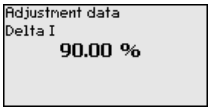
Here, you can retrieve the adjustment value of the sensor. This is the percentage value of the max. pulse rate at which the sensor switches over.

If you have carried out a single point adjustment, this is the entered value. With a two-point adjustment, this is the calculated value.

The value is an indication for the reliability and reproducibility of the switching point.

The greater the difference in the pulse rate between covered and uncovered status, the greater the differential value (Delta I) and the more reliable the measurement. The automatically calculated damping is also oriented around the Delta I value. The higher the value, the lower the damping.

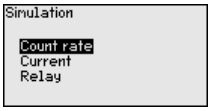
A Delta I value below 10 % is an indication for a critical measurement.



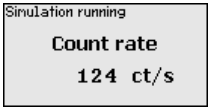
Diagnosis/Simulation

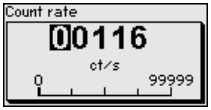
In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.

You can simulate different values:

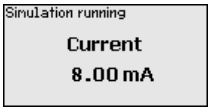


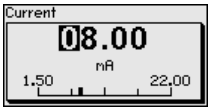
Pulse rate of the sensor



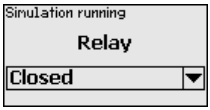


Current output





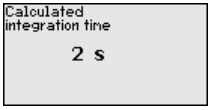
Switching function of the relay



Information:
The simulation is automatically terminated 10 minutes after the last pressing of a key.

Diagnosis - Calculated damping

The sensor calculates a suitable integration time automatically.



Additional adjustments

Additional settings - PIN

In this menu item, the PIN is permanently activated/deactivated. Thus you protect the sensor data against unauthorized access and unintended changes. The default setting of the PIN is 0000.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

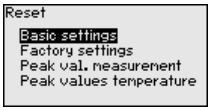
Additional adjustments - Date Time

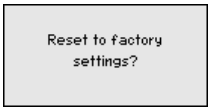
In this menu item you can set the actual date and time.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Additional adjustments/ Reset

When a reset is carried out, all settings (with only a few exceptions) are reset. The exceptions are: PIN, language, SIL and HART mode.





The following reset functions are available:

Basic settings: Resetting of the parameter adjustments to default values at the time of shipment. Order-specific settings are deleted.

Default settings: Resetting of the parameter adjustment like under "*Basic settings*". In addition, special parameters are reset to default values. Order-specific settings are deleted.

Peak values of measured value: Resetting of the parameter adjustments in the menu item "*Setup*" to the default values of the respective instrument. Order-specific settings remain but are not taken over into the current parameters.

Peak values of temperature: Resetting of the measured min. and max. temperatures to the actual measured value.

The following table shows the default values of the instrument. The values apply for the application "*Level*". First of all you have to select the application.

Depending on the instrument version, not all menu items may be available or they may be differently assigned:

Menu	Menu item	Default value
Setup	Measurement loop name	Sensor
	Isotope	Cs-137
	Application	Limit level
	Adjustment mode	Single point adjustment
	Adjustment - uncovered	90000 ct/s
	Adjustment - covered	9000 ct/s only with two-point adjustment
	Delta I	90 %
	Background radiation	0 ct/s
	Temperature unit	°C
	Damping	Is calculated automatically by the instrument
	Current output mode	8/16 mA, < 3.6 mA
	Mode - Relay	Overfill protection
	Block adjustment	Released
Display	Language	Selected language
	Displayed value	Pulse rate
Additional adjustments	Temperature unit	°C
	HART mode	Standard

Additional adjustments - HART mode

With this function you can select the mode.

The sensor offers the HART modes standard and multidrop.

If the measured value is outputted via the 4 … 20 mA output, you must not switch over to HART Multidrop.

The mode 'Standard', with fixed address 0 (factory setting), means output of the measured value as 8/16 mA signal.

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Additional adjustments - Copy instrument settings

With this function

- Load parameter adjustment data from the sensor into the display and adjustment module
- Write parameter adjustment data from the display and adjustment module into the sensor

This parameter is described in the operating instructions manual "*Display and adjustment module*".

Info

Info

In this menu you will find the following menu items:

- Instrument name - shows instrument name and serial number
- Instrument version - shows hardware and software version of the instrument
- Date of manufacture - shows calibration date and the date of the last change
- Instrument features - shows further instrument features

These parameters are described in the operating instructions manual "*Display and adjustment module*".

7.6 Saving the parameter adjustment data

We recommended noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If the instrument is equipped with a display and adjustment module, the data in the sensor can be saved in the display and adjustment module. The procedure is described in the operating instructions manual "*Display and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional adjustments*" the items "*Sensor-specific units, temperature unit and linearization*"
- The values of the user programmable linearization curve

The function can also be used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, the display and adjustment module is inserted into the replacement instrument and the data are likewise written into the sensor via the menu item "*Copy sensor data*".

8 Setup with PACTware

8.1 Connect the PC

Via the interface adapter directly on the sensor

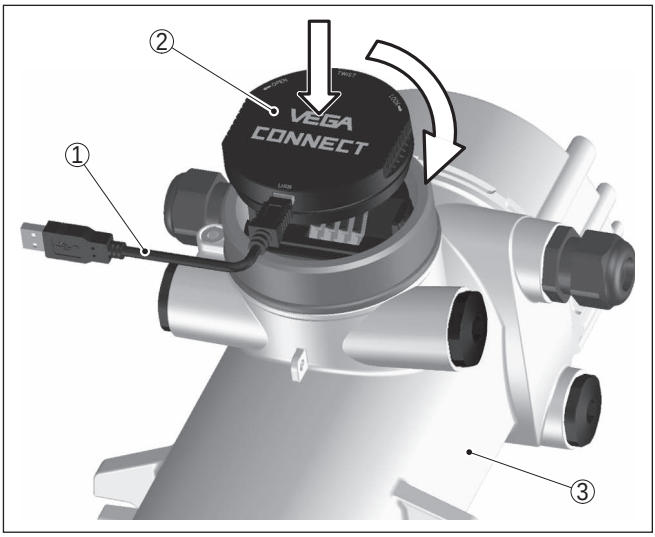


Fig. 18: Connection of the PC directly to the sensor via the interface adapter

1 USB cable to the PC
2 Interface adapter VEGACONNECT 4
3 ">Sensor

Information:
The interface adapter VEGACONNECT 3 is not suitable for connection to the sensor.

Connection via HART

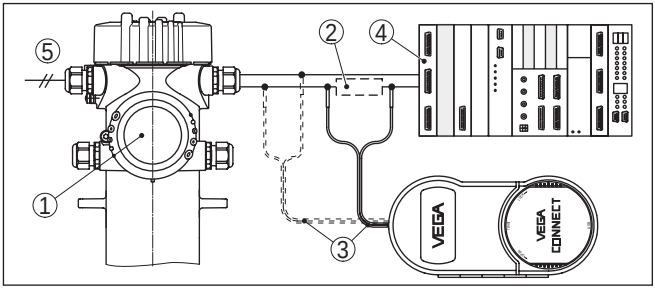


Fig. 19: Connecting the PC via HART to the signal cable

1 SOLITRAC 31
2 HART resistance 250 Ω (optional depending on processing)
3 Connection cable with 2 mm pins and terminals
4 Processing system/PLC/Voltage supply
5 Voltage supply

Necessary components:

- SOLITRAC 31
- PC with PACTware and suitable VEGA DTM
- VEGACONNECT 4
- HART resistance approx. 250 Ω
- Voltage supply

Note:
With power supply units with integrated HART resistance (internal resistance approx. 250 Ω), an additional external resistance is not necessary. This applies, e.g. to the VEGA instruments VEGATRENN 149A, VEGAMET 381 and VEGAMET 391). Commercially available Ex separators are also usually equipped with sufficient current limitation resistance. In such cases, VEGACONNECT 4 can be connected parallel to the 4 … 20 mA cable.

8.2 Parameter adjustment with PACTware

Prerequisites

For parameter adjustment of the sensor via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The up-to-date PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated into other frame applications according to FDT standard.

Note:
To ensure that all instrument functions are supported, you should always use the latest DTM Collection. Furthermore, not all described functions are included in older firmware versions. You can download the latest instrument software from our homepage. A description of the update procedure is also available in the Internet.

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware*" attached to each DTM Collection and which can also be downloaded from the Internet. Detailed descriptions are available in the online help of PACTware and the DTMs.

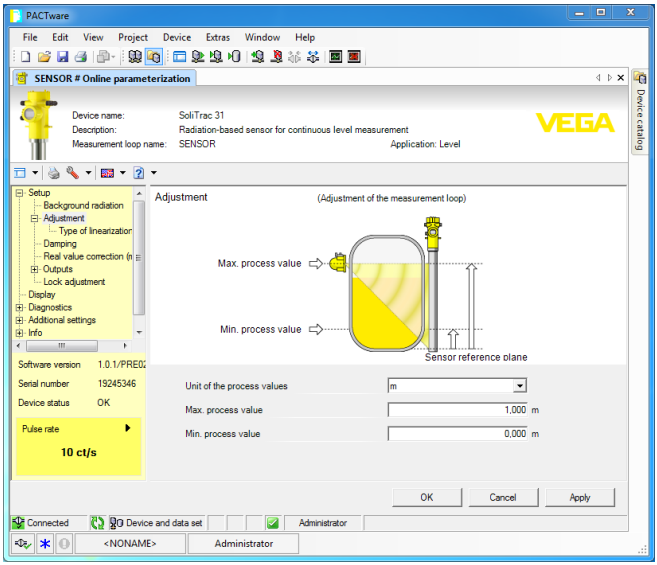


Fig. 20: Example of a DTM view

Standard/Full version

All device DTMs are available as a free-of-charge standard version and as a full version that must be purchased. In the standard version, all functions for complete setup are already included. An assistant for simple project configuration simplifies the adjustment considerably. Saving/printing the project as well as import/export functions are also part of the standard version.

In the full version there is also an extended print function for complete project documentation as well as a save function for measured value and echo curves. In addition, there is a tank calculation program as well as a multiviewer for display and analysis of the saved measured value and echo curves.

The standard version is available as a download under www.vega.com/downloads and "*Software*". The full version is available on CD from the agency serving you.

8.3 Saving the parameter adjustment data

We recommend documenting or saving the parameter adjustment data via PACTware. That way the data are available for multiple use or service purposes.

9 Diagnostics and service

9.1 Maintenance

If the device is used correctly, no maintenance is required in normal operation.

The corresponding source container must be checked in regular intervals. You can find further information in the operating instructions manual of the source container.

9.2 Status messages

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables there are more detailed error messages available under the menu item "*Diagnostics*" via the display and adjustment module, PACTware/DTM and EDD.

Status messages

The status messages are divided into the following categories:

- Failure
- Function check
- Out of specification
- Maintenance requirement

and explained by pictographs:

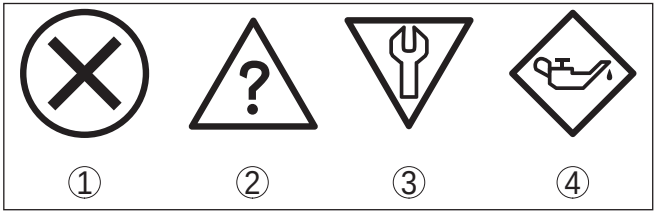


Fig. 21: Pictographs of the status messages

1 Failure - red
2 Out of specification - yellow
3 Function check - orange
4 Maintenance - blue

Failure: Due to a malfunction in the instrument, a failure message is outputted.

This status message is always active. It cannot be deactivated by the user.

Function check: The instrument is in operation, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Out of specification: The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Maintenance: Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Failure

The following table shows the error codes and text messages in the status message "*Failure*" and provides information on causes as well as corrective measures.

Example for a failure message

Code Text message	Cause	Rectification
F008 Error multi sensor communication	– Additional sensors not switched on – EMC influences – No other sensor available	– Check wiring between the sensors – Connect the sensors correctly and make them ready for operation
F013 Sensor signals a fault	– Error on the current input – No valid measured value – Connected instruments without function	– Check current input – Check connected instruments (Slaves)
F016 Adjustment data exchanged	– Values of the min. and max. adjustment exchanged	– Correct adjustment data
F017 Adjustment span too small	– The values of the min. and max. adjustment are too close together	– Correct adjustment data
F025 Invalid linearization table	– Empty linearization table – Wrong value in the linearization table	– Create linearization table – Correct linearization table
F030 Process value out of limits	– Process values are not within the adjusted measuring range	– Repeat adjustment
F034 EPROM hardware error	– Electronics defective	– Restart instrument – Exchanging the electronics
F035 EPROM data error	– Error in the internal instrument communication	– Carry out a reset – Exchanging the electronics

Code Text message	Cause	Rectification
F036 Faulty program memory	– Error during software update	– Repeat software update – Exchanging the electronics
F037 RAM hardware error	– Error in RAM	– Restart instrument – Exchanging the electronics
F038 Slave signals failure	– Connection cable to the Slave instrument interrupted – Instrument not defined as Slave instrument	– Check the connection cable to the Slave instrument – Define instrument as Slave
F040 Hardware error	– Sensor defective	– Restart instrument – Exchanging the electronics
F041 Photomultiplier error	– Error in the measured value recording	– Restart instrument – Exchanging the electronics
F045 Error on the current output	– Error on the current output	– Check wiring of the current output – Exchanging the electronics
F052 Faulty configuration	– Invalid parameter adjustment	– Carry out a reset
F066 Faulty adjustment	– Adjustment not yet carried out – Error during adjustment or when entering the linearization table	– Carrying out adjustment – Carry out linearization
F068 Count rate too high	– Faulty instrument settings	– Carry out a reset
F072 Limit exceeded	– Faulty instrument settings	– Carry out a reset
F073 Error real value correction	– Faulty real value correction	– Carry out real value correction again
F080 System error	– Instrument error	– Restart instrument – Call our service
F086 Communication error	– Error in the Fieldbus communication	– Restart instrument – Call our service
F114 Error real time clock	– Discharge accumulator	– Readjust real time clock

Code Text message	Cause	Rectification
F120 Filter time error	– Faulty or missing instrument adjustment	– Carrying out adjustment
F121 Faulty participant list on the multisensor communication bus	– Slave instruments not found	– Check Slave instruments – Check Slave list in Master instrument – Slave instrument with wrong address
F122 Double addresses on the multisensor communication bus	– Instrument addresse was assigned several times	– Change instrument addresses
F123 X-ray alarm	– External instruments cause radiation	– Determine reason for X-ray alarm – In case of brief X-ray radiation: Monitor switching outputs for this time manually
F124 Alarm due to increased radiation	– Radiation dose too high	– Determine reason for increased radiation
F125 Ambient temperature too high	– Ambient temperature on the housing outside the specification	– Cool the instrument or protect it with isolating material against radiation heat

Function check

The following table shows the error codes and text messages in the status message "*Function check*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
C029 Simulation	– Simulation active	– Finish simulation – Wait for the automatic end after 60 mins.

Out of specification

The following table shows the error codes and text messages in the status message "*Out of specification*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
S017 Accuracy outside the specification	– Accuracy outside the specification	– Correct adjustment data
S025 Bad linearization table	– Bad linearization table	– Carry out linearization
S038 Slave outside the specification	– Slave outside the specification	– Check Slave
S125 Ambient temperature too high/too low	– Ambient temperature too high/too low	– Protect instrument with isolating material against extreme temperatures

Maintenance

The instrument has no status messages to the section "*Maintenance*".

9.3 Rectify faults

Reaction when malfunctions occur

The operator of the system is responsible for taking suitable measures to rectify faults.

Procedure for fault rectification

The first measures are:

- Evaluation of fault messages, for example via the display and adjustment module
- Checking the output signal
- Treatment of measurement errors

Further comprehensive diagnostics options are available with a PC with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified.

Check 4 … 20 mA signal (level measurement)

Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to remove them:

Error	Cause	Rectification
4 … 20 mA signal not stable	Level fluctuations	Set damping according to the instrument via the display and adjustment module or PACTware/DTM

Error	Cause	Rectification
4 … 20 mA signal missing	Electrical connection faulty	Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"
	Voltage supply missing	Check cables for breaks; repair if necessary
	Operating voltage too low or load resistance too high	Check, adapt if necessary
Current signal greater than 22 mA or less than 3.6 mA	Instrument on failure message	Note error message on the display and adjustment module

Check output signal (level detection)

The following table describes possible faults that may not generate an error message:

Error	Cause	Rectification
The instrument signals covered without covering with the medium The instrument signals covered with covering with the medium	Voltage supply missing	Check cables for breaks; repair if necessary
	Operating voltage too low or load resistance too high	Check, adapt if necessary
	Electrical connection faulty	Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"
	Electronics defective	Change the switching behaviour of the sensors under "Diagnosis/Simulation". If the instrument does not switch over, send it in for repair.
	Buildup on the inner wall of the vessel	Remove buildup Check the Delta I value. Improve the switching threshold - carry out a double point adjustment
Current signal greater than 22 mA or less than 3.6 mA	Electronics module in the sensor defective	Note error messages on the display and adjustment module

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Setup*" must be carried out again or must be checked for plausibility and completeness.

24 hour service hotline

Should these measures not be successful, please call in urgent cases the VEGA service hotline under the phone no. **+49 1805 858550**.

The hotline is also available outside normal working hours, seven days a week around the clock.

Since we offer this service worldwide, the support is provided in English. The service itself is free of charge, the only costs involved are the normal call charges.

9.4 Exchanging the electronics module

If the electronics module is defective, it can be replaced by a VEGA service technician.

SIL With SIL qualified instrument, only a respective electronics module with SIL qualification must be used.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

The new electronics module must be loaded with the default settings of the sensor. These are the options:

- In the factory
- On site by the service technician

9.5 Software update

The following components are required to update the sensor software:

- Sensor
- Voltage supply
- Interface adapter VEGACONNECT
- PC with PACTware
- Current sensor software as file

You can find the actual sensor software as well as detailed information of the procedure under "www.vega.com/downloads" and "*Software*".

You can find information about the installation in the download file.

Caution:
Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval remains effective with a software update.

You can find detailed information on www.vega.com/downloads and "*Approvals*".

9.6 How to proceed in case of repair

The following procedure refers only to the sensor. Should a repair of the source container be necessary, you can find the respective instructions in the operating instructions manual of the source container.

You can find a repair form as well as detailed information on how to proceed under www.vega.com/downloads and "*Forms and certificates*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

If a repair is necessary, please proceed as follows:

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please contact the agency serving you to get the address for the return shipment. You can find the agency on our home page www.vega.com.

10 Dismounting

10.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

10.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the parts to be easily separable.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

11 Supplement

11.1 Technical data

General data	
316L corresponds to 1.4404 or 1.4435	
Materials, non-wetted parts	
– Detector tube	316L
– Scintillation material	PVT (Polyvinyltoluene)
– Aluminium die-casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing	316L
– Seal between housing and housing cover	NBR (stainless steel housing, investment casting), silicone (Aluminium housing)
– Inspection window in housing cover (optional)	Polycarbonate
– Ground terminal	316L
– Mounting accessory	316L
Process fittings	
– Fastening lugs	ø 9 mm (0.35 in), hole centre distance 119 mm (4.69 in)
Weight	
– Aluminium housing, with electronics	3.4 kg (7.5 lbs) + measurement tube
– Stainless steel housing, with electronics	8.36 kg (18.43 lbs) + measurement tube
– Measurement tube	7.1 kg/m (4.77 lbs/ft)
Max. torque, mounting screws - fastening lugs on the sensor housing	50 Nm (36.88 lbf ft)
Max. torque for NPT cable glands and Conduit tubes	
– Aluminium/Stainless steel housing	50 Nm (36.88 lbf ft)

Input variable	
Measured variable	The measured variable is the intensity of the gamma radiation of an isotope. When the radiation intensity decreases, for example due to rising medium, the measured value of SOLITRAC 31 changes in proportion to the level.

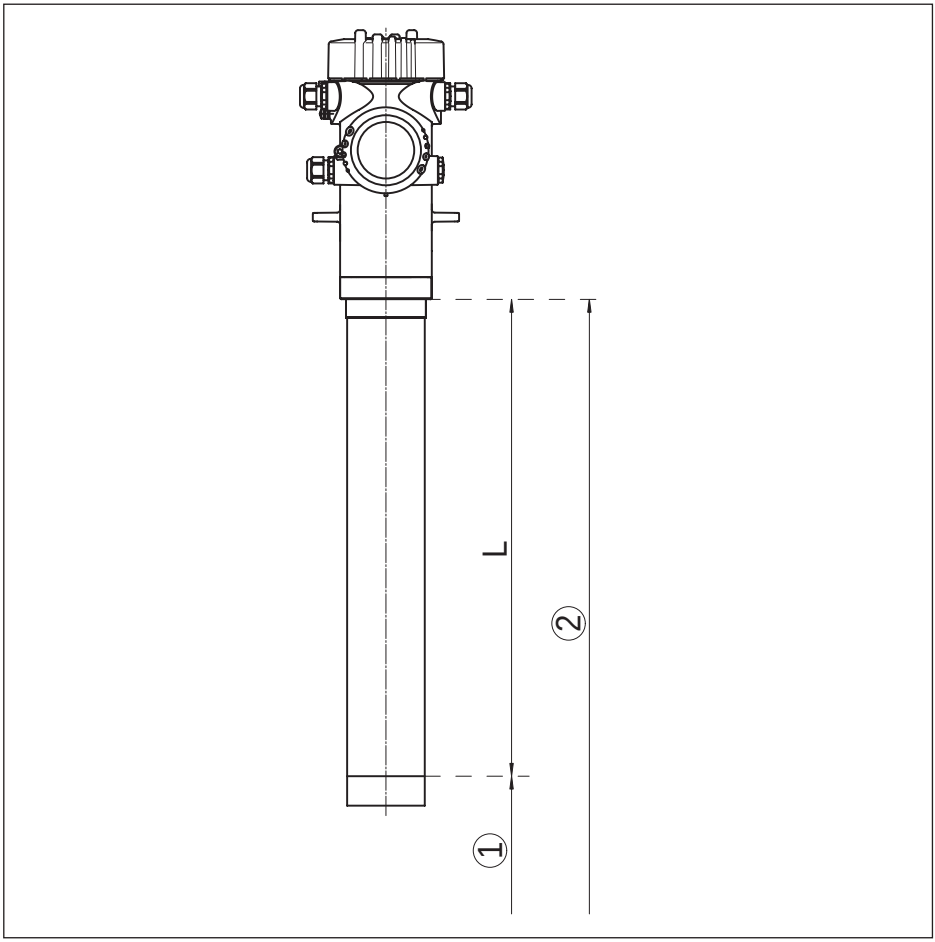


Fig. 22: Data of the input variable

1 Min. level (red marking line)
2 Max. level
L Measuring range

Measuring range (L)	500 … 3000 mm (19.69 … 118.1 in)
Analogue input	
– Input type	4 … 20 mA, passive
– Internal load	250 Ω
Switching input	
– Type of input - Open Collector	10 mA
– Type of input - Relay contact	100 mA

Output variable - Level measurement	
Output signals	4 … 20 mA/HART - active; 4 … 20 mA/HART - passive
Range of the output signal	3.8 … 20.5 mA/HART
Terminal voltage passive	9 … 30 V DC
Shortcircuit protection	Available
Potential separation	Available
Signal resolution	0.3 µA
Failure signal current output (adjustable)	22 mA, < 3.6 mA
Max. output current	22 mA
Starting current	≤ 3.6 mA
Load	
– 4 … 20 mA/HART - active	< 500 Ω
– 4 … 20 mA/HART - intrinsically safe	< 300 Ω
Damping (63 % of the input variable)	1 … 1200 s, adjustable
HART output values	
– PV (Primary Value)	Level
– SV (Secondary Value)	Electronics temperature

Output variable - Level detection	
Output signals	8/16 mA
Terminal voltage passive	9 … 30 V DC
Shortcircuit protection	Available
Potential separation	Available
Failure signal current output (adjustable)	22 mA, < 3.6 mA
Max. output current	22 mA
Starting current	≤ 3.6 mA
Load	
– 4 … 20 mA/HART - active	< 500 Ω
– 4 … 20 mA/HART - intrinsically safe	< 300 Ω
Damping (63 % of the input variable)	Automatically
HART output values	
– PV (Primary Value)	Switching status
– SV (Secondary Value)	Electronics temperature

Relay output	
Output	Relay output (SPDT), floating spdt
Switching voltage	
– Min.	10 mV
– Max.	253 V AC, 253 V DC
Switching current	
– Min.	10 µA

– Max.	3 A AC, 1 A DC
Breaking capacity	
– Min.	50 mW
– Max.	750 VA AC, 40 W DC
	If inductive loads or stronger currents are switched through, the gold plating on the relay contact surface will be permanently damaged. The contact is then no longer suitable for switching low-level signal circuits.
Contact material (relay contacts)	AgNi or AgSnO and Au plated

Accuracy (according to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1	
– Temperature	+18 … +30 °C (+64 … +86 °F)
– Relative humidity	45 … 75 %
– Air pressure	860 … 1060 mbar/86 … 106 kPa (12.5 … 15.4 psig)
Repeatability	≤ 0.5 %
Deviation with bulk solids	The values depend to a great extent on the application. Binding specifications are thus not possible.
Deviation under EMC influence	≤ 1 %

Variables influencing measurement accuracy

Specifications apply also to the current output

Temperature drift - Current output	±0.03 %/10 K relating to the 16 mA span max. ±0.3 %
Deviation on the current output through analogue/digital conversion	<±15 µA
Deviation on the current output due to strong, high frequency electromagnetic interference acc. to EN 61326	<±150 µA

Characteristics and performance data

Step response time[5)]	≤ 5 s (with damping 1 s)

Ambient conditions

Ambient, storage and transport temperature	-40 … +60 °C (-40 … +140 °F)

Process conditions

For the process conditions, please also note the specifications on the type label. The lower value always applies.

Process pressure	Unpressurized

5) Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

Process temperature (measured on the detector tube)	-40 … +60 °C (-40 … +140 °F) With temperatures of more than 60 °C we recommend the use of water cooling
Vibration resistance[6)]	mechanical vibrations up to 1 g in the frequency range 5 … 200 Hz

Electromechanical data - version IP 66/IP 67

Cable entry	
– M20 x 1.5	2 x cable gland M20 x 1.5 (cable: ø 6 … 12 mm), 4 x blind plug M20 x 1.5 Included: 1 x cable gland M20 x 1.5
– ½ NPT	5 x closing cap (red) ½ NPT Included: 3 x cable gland ½ NPT (cable: ø 6 … 12 mm), 4 x blind plug ½ NPT
Spring-loaded terminals for wire cross-section	
– Massive wire, cord	0.2 … 2.5 mm² (AWG 24 … 14)
– Stranded wire with end sleeve	0.2 … 1.5 mm² (AWG 24 … 16)

Display and adjustment module

Display element	Display with backlight
Measured value indication	
– Number of digits	5
– Size of digits	W x H = 7 x 13 mm
Adjustment elements	4 keys
Protection rating	
– unassembled	IP 20
– mounted into the housing without cover	IP 40
Materials	
– Housing	ABS
– Inspection window	Polyester foil

Integrated clock

Date format	Day.Month.Year
Time format	12 h/24 h
Time zone Ex factory	CET
Rate deviation max.	10.5 min/year

Measurement electronics temerature

Resolution	1 °C (1.8 °F)
Accuracy	±1 °C (1.8 °F)

6) Tested according to the guidelines of German Lloyd, GL directive 2.

Voltage supply	
Operating voltage	20 … 72 V DC or 20 … 253 V AC, 50/60 Hz
Interpolation protection	Available
Max. power consumption	6 VA (AC); 4 W (DC)

Electrical protective measures	
Protection, depending on housing version	IP 66/IP 67[7)]
Overvoltage category	III
Protection class	I

Approvals

Instruments with approvals can have different technical data depending on the version.

For that reason the associated approval documents of these instruments must be carefully noted. They are part of the delivery or can be downloaded under www.vega.com and "*VEGA Tools*" as well as under "Downloads" and "*Approvals*".

11.2 Dimensions

The following dimensional drawings represent only an extract of all possible versions. Detailed dimensional drawings can be downloaded at www.vega.com/downloads under "*Drawings*".

7) A suitable cable is the prerequisite for maintaining the protection rating.

Aluminium and stainless steel housing

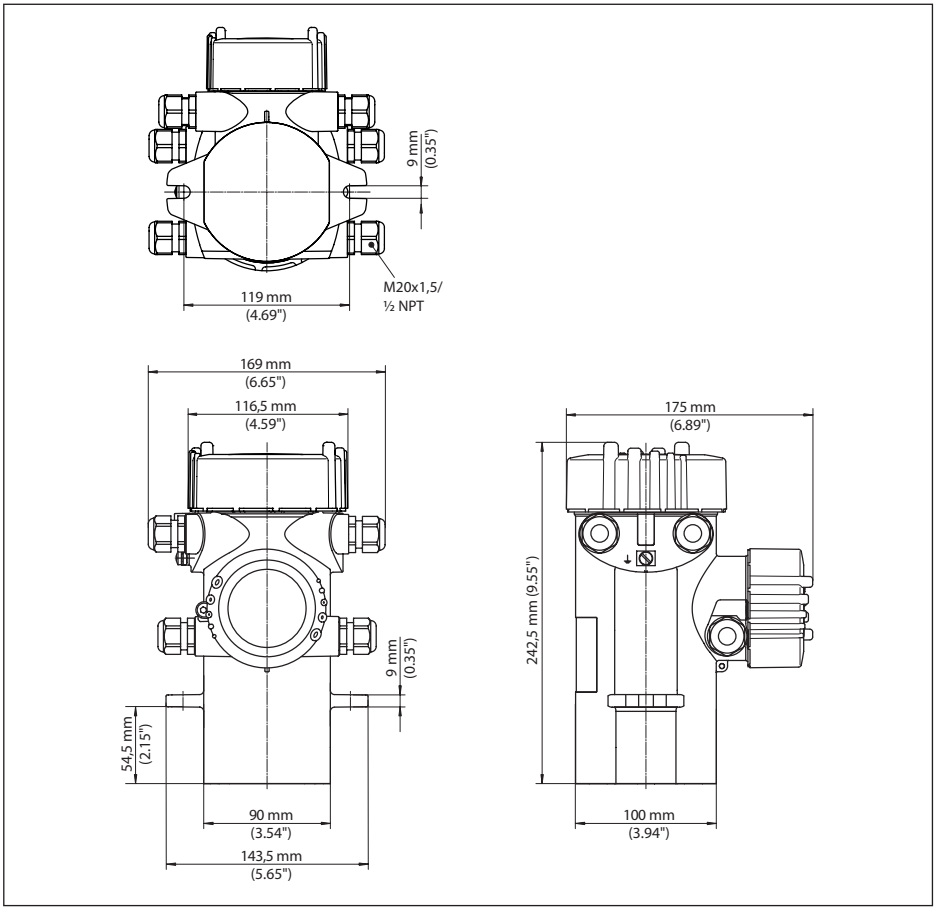


Fig. 23: Aluminium housing or stainless steel housing - Precision casting

SOLITRAC 31

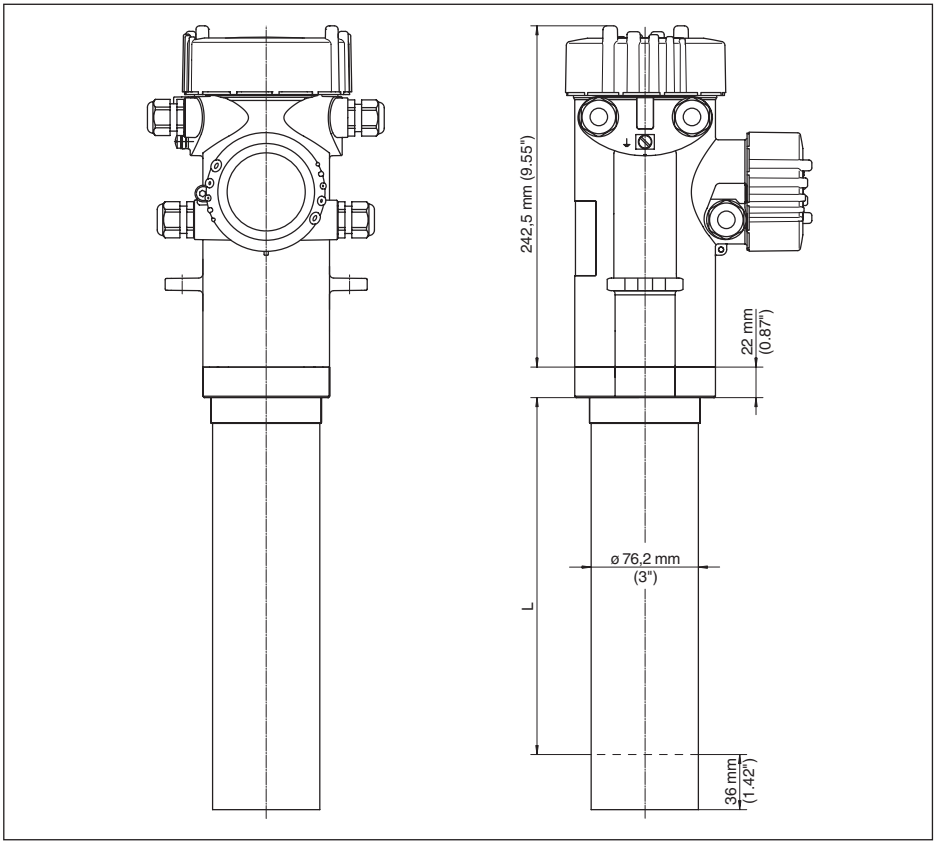


Fig. 24: SOLITRAC 31

L Measuring range

SOLITRAC 31 - Mounting example

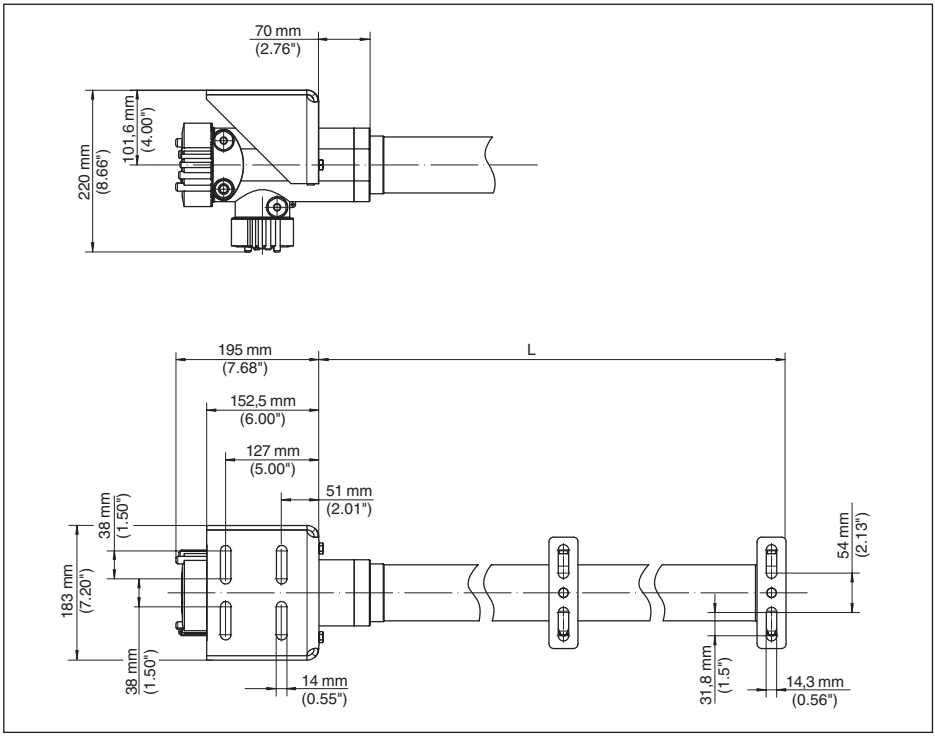


Fig. 25: SOLITRAC 31 with supplied mounting accessories

L Measuring range

11.3 Industrial property rights

VEGA product lines are global protected by industrial property rights. Further information see www.vega.com.

Only in U.S.A.: Further information see patent label at the sensor housing.

VEGA Produktfamilien sind weltweit geschützt durch gewerbliche Schutzrechte.

Nähere Informationen unter www.vega.com.

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进一步信息请参见网站<www.vega.com>。

11.4 Trademark

All the brands as well as trade and company names used are property of their lawful proprietor/ originator.

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